



# **NAVAL POSTGRADUATE SCHOOL**

**MONTEREY, CALIFORNIA**

**Physical, Nutrient, and Biological Measurements of  
Coastal Waters off Central California in June 2008**

by

Thomas A. Rago, Reiko Michisaki, Baldo Marinovic, Marguerite Blum, and  
Katherine Whitaker

December 2008

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Prepared for: Marine Sciences Institute,  
University of California, Santa Cruz

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## **Introduction**

Following in a long tradition of hydrographic studies of the California Current system-- see, for example, Steger *et al.* (2000) and Collins *et al.* (2003)-- the data in this report were collected during the 23-27 June 2008 cruise of the Pacific Coast Ocean Observing System (PaCOOS) program aboard the *R/V Point Sur*. The PaCOOS program was organized in 2003/2004 as the NOAA west coast contribution to the national Integrated Ocean Observing System (IOOS), and is charged with “providing ocean information for the sustained use of the California Current Large Marine Ecosystem under a changing climate.”<sup>1</sup> PaCOOS cruises generally subsample the standard California Cooperative Oceanic Fisheries Investigations (CalCOFI) grid of hydrographic stations (Figure 1). This cruise was scheduled to do exactly that by sampling along CalCOFI lines 60 and 67 between stations 90 and the mainland shore. However, because of weather unusually heavy for the time of year, this cruise struggled to sample along CalCOFI line 67 to station 75 (Figure 2). Since it has been normal procedure for these cruises to sample not only at standard CalCOFI stations but also halfway between those standard stations along CalCOFI line 67 (Rago *et al.*, 2006, 2007a, 2007b, 2007c, 2008), this resulted in 11 hydrographic stations (CTDs 1-11) completed, as well as 7 net tows at the standard CalCOFI stations. An additional three hydrographic stations were completed along the California coast after it became evident that nothing more could be accomplished in the remaining time further offshore along CalCOFI line 67. This coastal work did serve to allow us to get very good marine mammal observations in an area known to teem with marine mammals. Participants on the cruise came from the Naval Postgraduate School (Physical Oceanography, Marine Mammal Observations), the Monterey Bay Aquarium Research Institute (Nutrient Analysis and Primary Productivity), the University of California at Santa Cruz (Zooplankton and Nutrient Analyses), and the Marine Advanced Technology Education (MATE) Internship Program<sup>2</sup>.

## **Standard Procedures**

### *CTD/Rosette Data:*

At each site a Seabird Electronics, Inc., Conductivity-Temperature-Depth (CTD) instrument fitted with a 12-place rosette was deployed. The rosette was equipped with 12 10-liter PVC Niskin bottles for collection of water samples. The CTD was lowered to 1000 meters or the bottom (whichever came first). Where primary productivity sampling was performed, water samples were taken at depths designed to maximize resolution of the variables sampled throughout the thermocline. Where only nutrient sampling was performed<sup>3</sup>, water samples were more or less evenly spaced throughout the water column. A water sample was always obtained at or near the bottom of each CTD cast for later conductivity/salinity calibration of the CTD conductivity sensors.

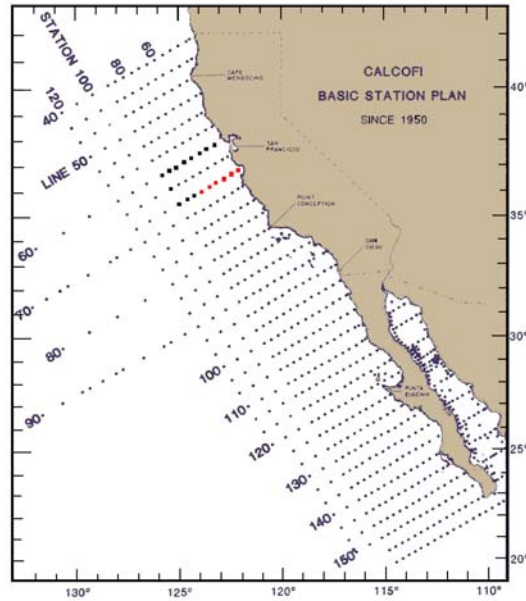
Besides temperature (dual sensors), conductivity (dual sensors), and pressure, the CTD also measured fluorescence, transmissivity, dissolved oxygen content, and photosynthetically available radiation (PAR) in the water column. Except for PAR and the secondary of the dual sensors, all these parameters are reported here.

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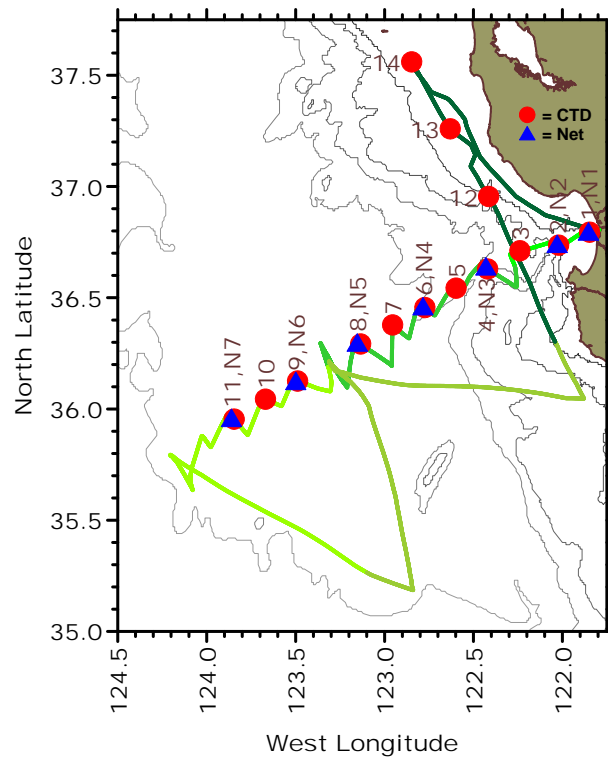
<sup>1</sup> <http://www.pacoos.org>

<sup>2</sup> <http://www.marinetech.org>

<sup>3</sup> CTD stations 3, 5, 7, and 10.



**Figure 1:** *Full CalCOFI hydrographic station grid. Stations occupied during the PaCOOS cruise of June 2008 are highlighted in red.*



**Figure 2:** *Hydrographic stations occupied during the PaCOOS cruise of June 2008. 200, 1000, 2000, 3000, and 4000 m isobaths are shown. The ship's erratic (due to heavy weather) track is shown in green, where different shades represent different days. Net tows were completed at the sites marked by blue triangles.*

Generally, a minimum of two salinity samples (including the bottom-of-cast sample) were collected from each CTD cast. These samples were analyzed after the cruise at the Naval Postgraduate School (NPS) using a Guildline model 8400B Autosol salinometer. A regression between the salinometer results and the conductivities measured by the CTD at the times the Niskin bottles were tripped was made, from which a correction to the CTD salinities was determined and then applied. The salinometer was standardized using IAPSO Standard Seawater (batch P147) before and after each set of water samples was analyzed. Salinity values were calculated using the algorithms for the Practical Salinity Scale, 1978 (UNESCO, 1981).

Dissolved oxygen (Winkler) samples were collected at CTD stations 3, 10, 12, 13, and 14. These were analyzed after the cruise at the Monterey Bay Aquarium Research Institute (MBARI). The CTD for this cruise was outfitted with a Sea-Bird Electronics, Inc., SBE 43 oxygen sensor. This sensor is a polarographic membrane that outputs a voltage proportional to the temperature-compensated current flow occurring when oxygen is reacted inside the membrane. Dissolved oxygen concentration is then calculated from a modified version of the algorithm by Owens and Millard (1985). The results of the analysis of the Winkler oxygen samples were compared to the corresponding oxygen values recorded by the CTD. Using the method described in SBE Application Note #64-2<sup>4</sup>, we calculated new SBE 43 sensor coefficients. Corrected CTD oxygen values were then recalculated with the modified version of the Owens and Millard (1985) algorithm using the new sensor coefficients.

For this cruise, the CTD was fitted with a Seatech<sup>5</sup> 25-cm. transmissometer. This instrument is designed to measure beam transmission over a 25 centimeter water path using a modulated Light Emitting Diode (660 nm, in this case) and a synchronous detector. The temperature compensated transmissometer is not sensitive to ambient light. (For further details concerning the Seatech transmissometer, the introduction from its operating manual is reprinted in Appendix C.)

Nutrient samples were collected in 45-ml polypropylene screw-capped containers which were rinsed three times prior to filling. Samples were frozen and returned to MBARI for later analysis on an AlpChem autoanalyzer, as in Sakamoto *et al.* (1990).

Chlorophyll-*a* and phaeopigments were collected in 280-ml polyethylene bottles and filtered onto 25-mm Whatmann GF/F filters. Chlorophyll-*a* was assayed with the standard fluorometric procedure of Holm-Hansen *et al.* (1965), modified such that phaeopigments are extracted in acetone in a freezer over at least 24 hours (Venrick and Hayward, 1984; Chavez *et al.*, 1991). Analysis was performed as possible during the cruise or at MBARI immediately following the cruise.

Primary productivity was estimated for the 100, 50, 15, 5, 1, and 0.1% light penetration depths as determined by secchi, and followed the general method of Parsons *et al.* (1984). Water samples from the appropriate depths were collected in 280-ml polycarbonate bottles, spiked with <sup>14</sup>C, and incubated on deck for 24 hours under running seawater in plexiglass tubes wrapped with nickel-cadmium screens of differing pore size. (See Pennington and Chavez, 2000, for methodology details.)

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<sup>4</sup>See **Application notes** under the **Support** tab at <http://www.seabird.com>.

<sup>5</sup> Seatech, Inc. was acquired by Wet Labs, Inc. in late 1998.

## *Zooplankton Net Tows:*

Seven stations<sup>6</sup> (Figure 2 and Table1) were sampled for zooplankton during the cruise. All sampling was conducted with 0.7-m diameter paired bongo nets fitted with 505-mm mesh, which were towed obliquely to a depth of 210 m (or within 10 m of the bottom, whichever came first). Samples were preserved at sea according to standard protocols (Kramer *et al.*, 1972). Upon return to the University of California at Santa Cruz (UCSC), all samples were initially measured for total biovolume and subsequently processed for krill species composition and abundance.

### *Zooplankton Displacement Volume:*

Zooplankton displacement volumes for 2008 were comparable to those observed in June 2007. Mean zooplankton displacement for the inshore portion of the June 2007 cruise (199.87 ml/1000m<sup>3</sup>) was not significantly different than that collected during the June 2008 cruise (182.76 ml/1000m<sup>3</sup>). However, the distribution of biomass demonstrated a slightly offshore shift in 2008 relative to 2007 (Figure 3), due most likely to stronger levels of coastal upwelling and corresponding offshore Ekman transport in 2008 versus 2007.

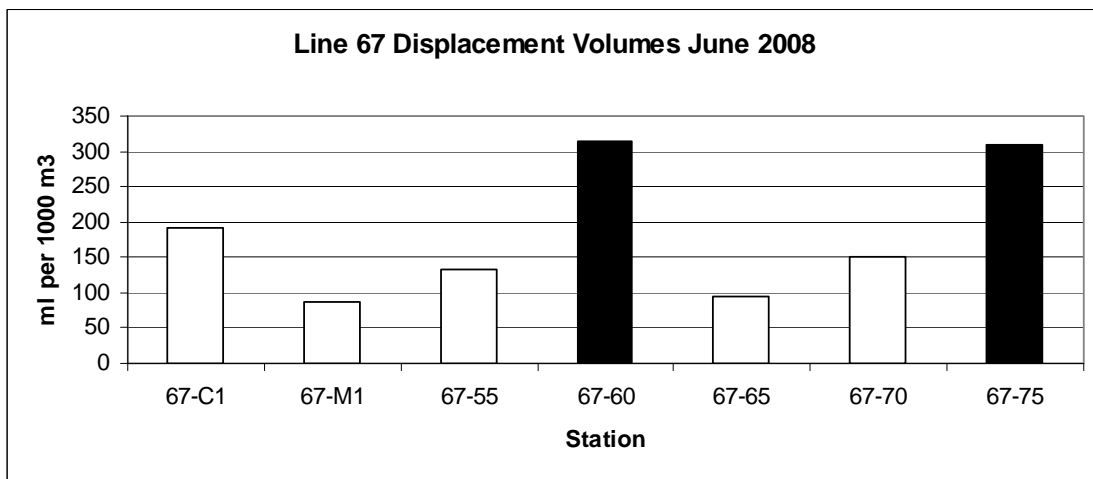
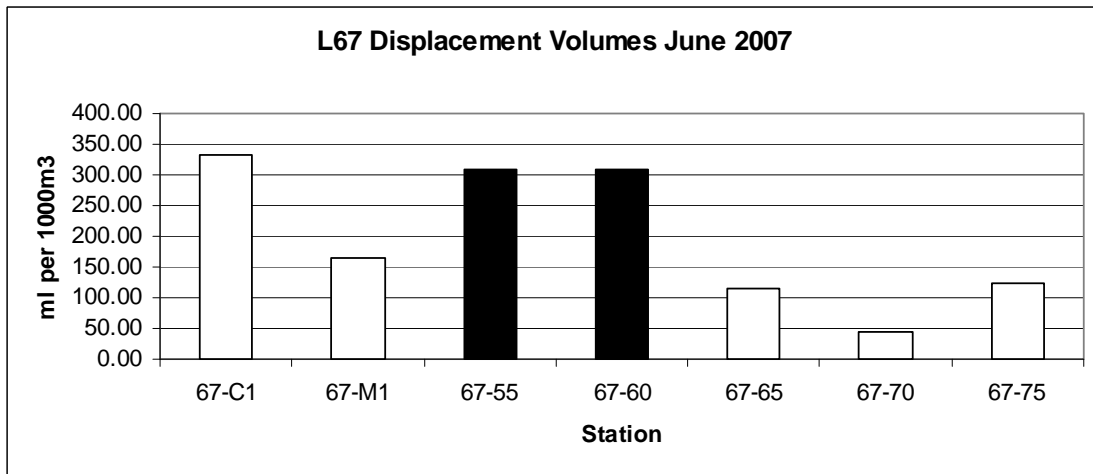
### *Krill:*

A total of 5 species of krill were collected in net samples from CalCOFI line 67, although two species, *Euphausia pacifica* and *Nematoscelis difficilis*, constituted 99% of all krill collected. This was comparable to the June 2007 cruise, which had a total of 4 species collected within the comparable region. Relative abundances were not significantly different between the 2007 and 2008 samples for both *E. pacifica* and *N. difficilis*. Onshore/offshore distributions for *E. pacifica* were similar for both 2007 and 2008 (Figure 4), while *N. difficilis* had a slightly more inshore maximum in 2008 compared to that in 2007 (Figure 5).

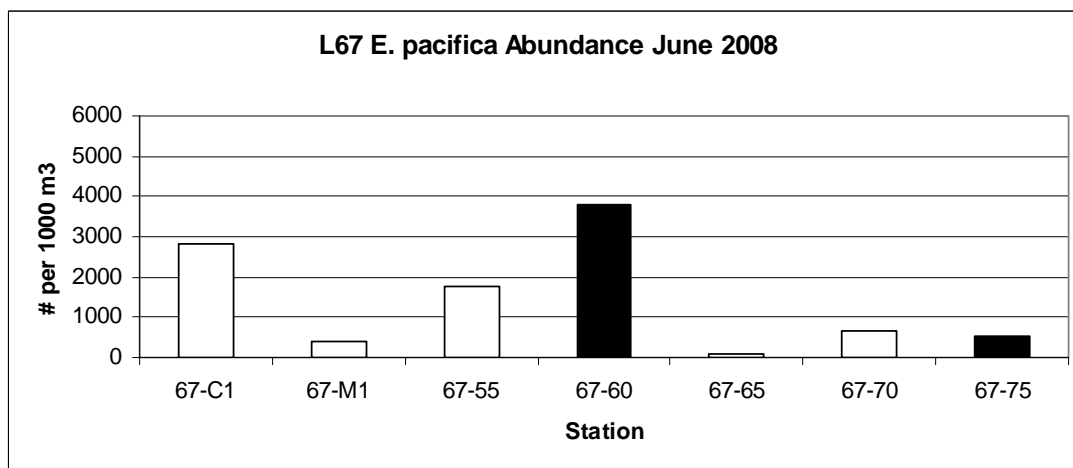
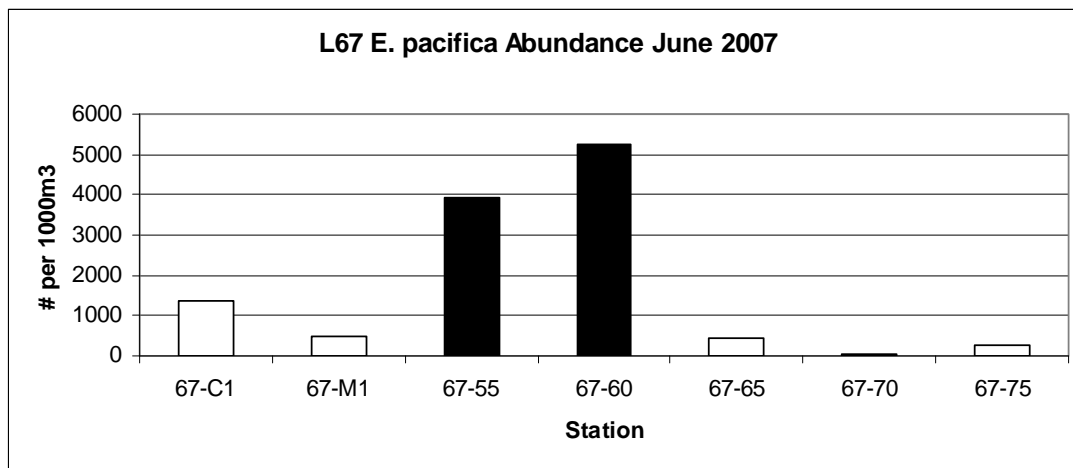
**Table 1:** *Zooplankton data.* This table lists the total biovolume (displacement) abundance, as well as the mean abundances of the three dominant euphausiid species (*Euphausia pacifica*, *Thysanoessa spinifera*, and *Nematoscelis difficilis*), measured at the seven hydrographic stations sampled by bongo net tows along CalCOFI line 67 during the PaCOOS cruise of June 2008. The data are listed onshore to offshore.

Station (CalCOFI) Number	Zooplankton Biovolume (ml/1000m <sup>3</sup> )	<i>E. pacifica</i> Abundance (no./1000m <sup>3</sup> )	<i>T. spinifera</i> Abundance (no./1000m <sup>3</sup> )	<i>N. difficilis</i> Abundance (no./1000m <sup>3</sup> )
1 (67-C1)	191	2840	0	863
2 (67-M1/H3)	86	397	0	15
4 (67-55)	134	1766	0	241
6 (67-60)	315	3800	0	309
8 (67-65)	95	70	0	6
9 (67-70)	150	681	0	13
11 (67-75)	309	539	0	366

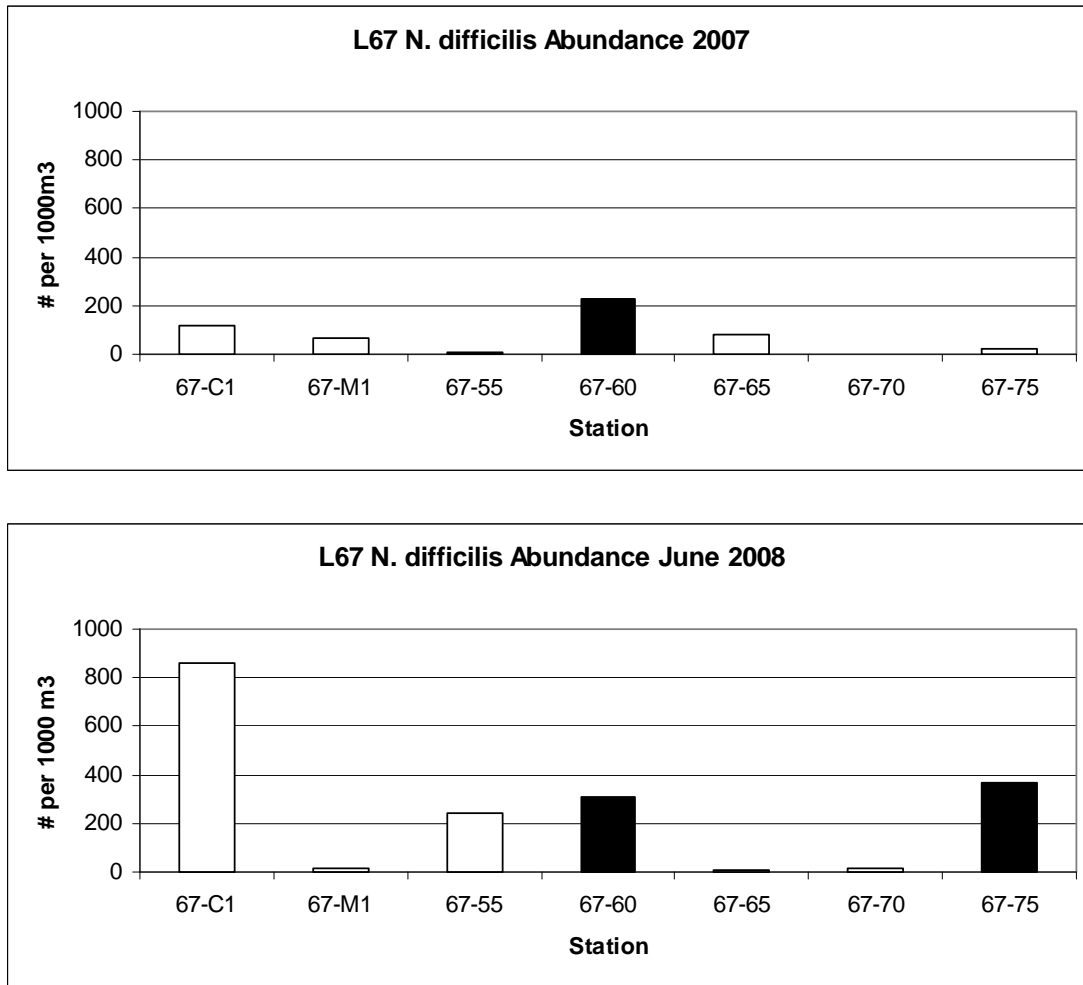
<sup>6</sup> CTD stations 1, 2, 4, 6, 8, 9, and 11.



**Figure 3:** *Zooplankton volume displacements for CalCOFI line 67 during the PaCOOS cruises of June 2007 (top) and June 2008 (bottom). Samples are arranged onshore (67-C1) to offshore (67-75), with nighttime sampling shown by black bars.*



**Figure 4:** *Euphausia pacifica* abundance for CalCOFI line 67 during the PaCOOS cruises of June 2007 (top) and June 2008 (bottom). Samples are arranged onshore (67-C1) to offshore (67-75), with nighttime sampling shown by black bars.



**Figure 5:** *Nematoscelis difficilis* abundance for CalCOFI line 67 during the PaCOOS cruises of June 2007 (top) and June 2008 (bottom). Samples are arranged onshore (67-C1) to offshore (67-75), with nighttime sampling shown by black bars.

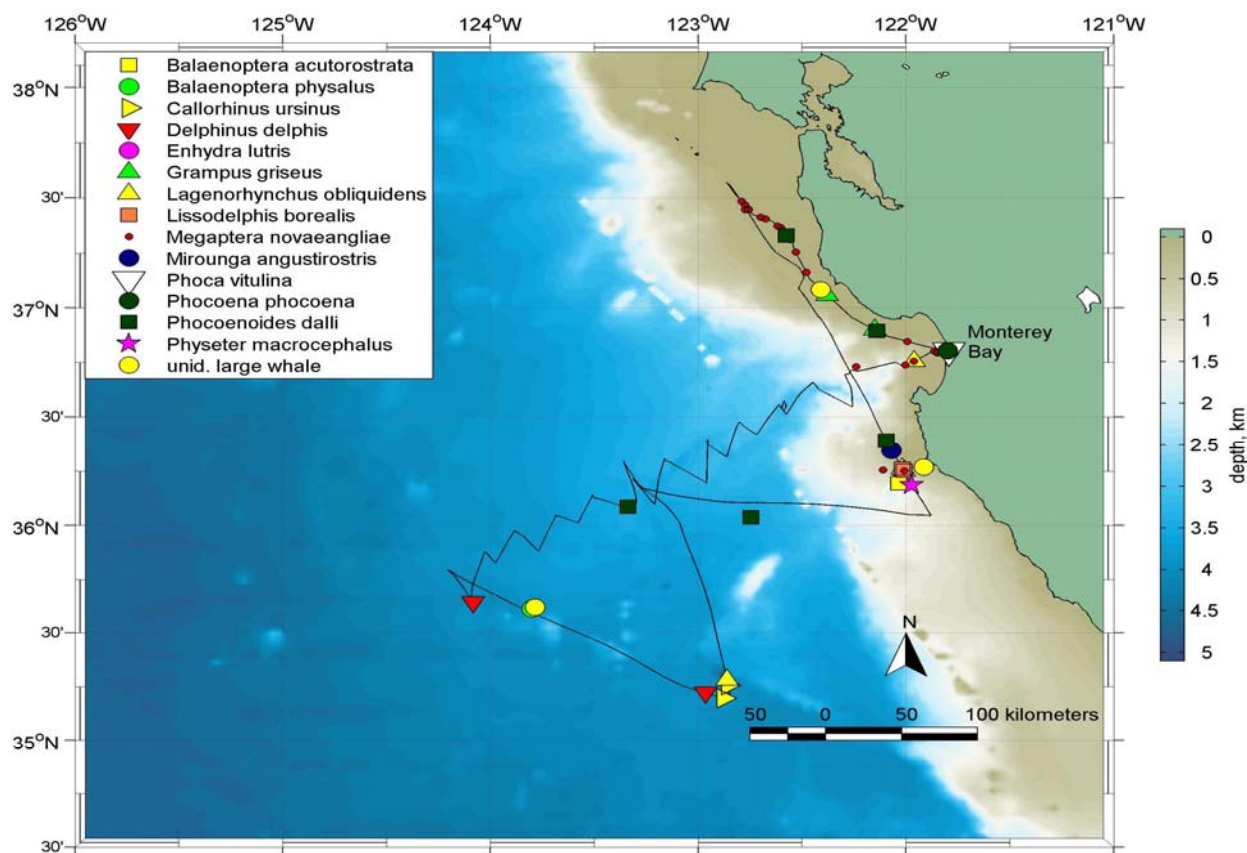
#### *Marine Mammal Observations:*

Observations of marine mammals (Figure 6, Tables A4 and A5) were made by a single observer during daylight hours (approximately 1300 to 0300 Coordinated Universal Time [UT]) throughout the cruise, conditions permitting (e.g., clear or high clouds, Beaufort state less than 4, etc.). Observations were made from the 02-deck (outside the Bridge), where eye height was approximately 20 meters above the sea surface, using handheld Fujinon 7 x 50 binoculars with compass for bearing and reticle for distance. Observations were recorded on a laptop computer using the marine mammal and bird mapping program *Seebird* (developed at the Southwest Fisheries Science Center). This program interfaces with handheld global positioning system (GPS) devices, and allows the generation of observation logs containing the observations of the mammals themselves with matching ship's velocities and positions, observational conditions, etc. Generally, intensive "on effort" observations were made during the last half of each half-hour period, with the other half of the half-hour period devoted to less intensive "off effort" observations. Depending on



the situation, the observer would take short breaks from the observations approximately every two hours.

During this cruise, conditions were often far less than ideal. High winds (see Table A1) gusting as high as 60 knots offshore caused Beaufort states above 7. Although the winds were much tamer close to shore, visibility nevertheless was severely restricted there due to smoke and ash from the hundreds of wildfires that were burning out of control across central California. Despite these conditions, observations were attempted and were surprisingly often productive.<sup>7</sup>



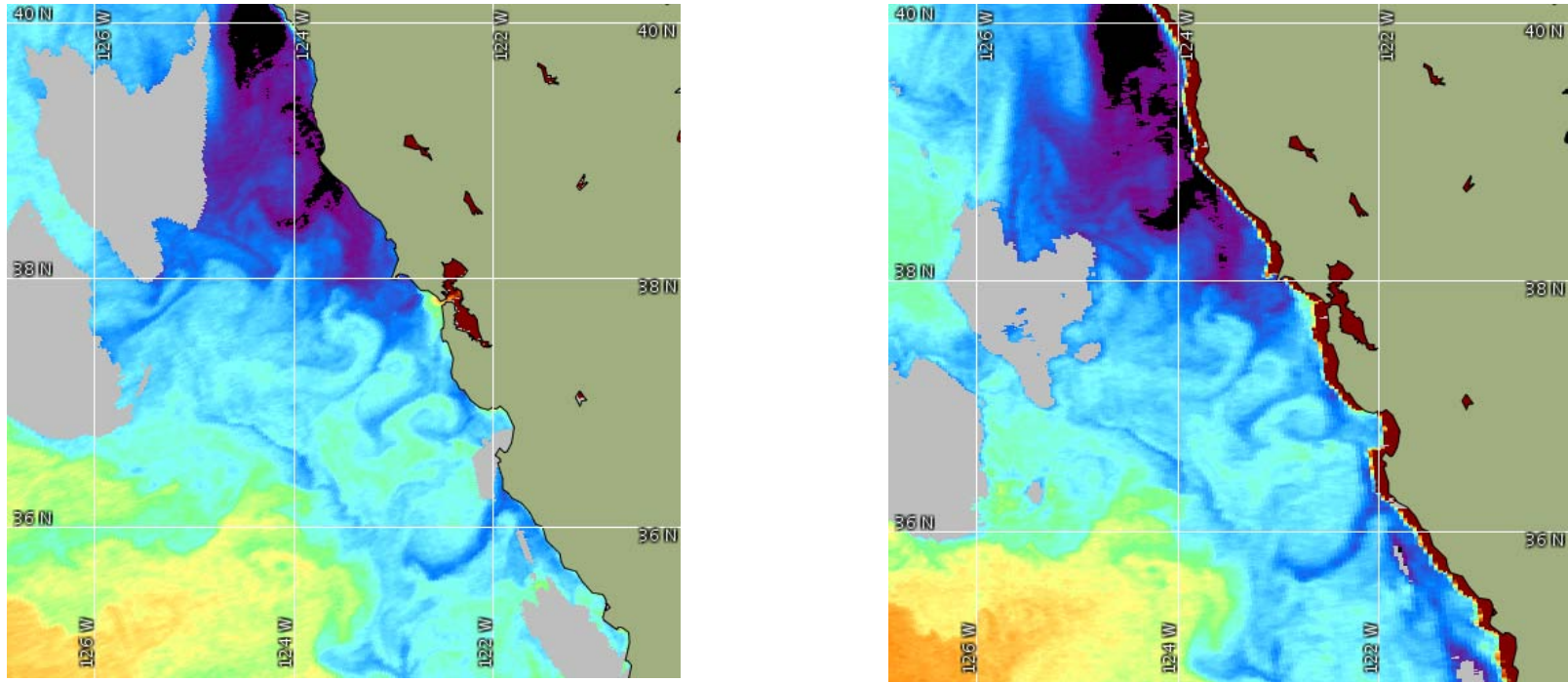
**Figure 6.** Marine mammal sightings during the PaCOOS cruise of June 2008. The black line shows the track of the ship.

#### *Ancillary Observations:*

*Underway Data:* Near surface measurements of temperature and salinity were recorded throughout the cruise from water pumped through the ship's uncontaminated seawater system. These data, along with meteorological data (barometric pressure, wind, etc.) collected from various sensors mounted primarily on the ship's mast, were recorded at approximately 30-second intervals throughout the cruise. Table A1 lists these data at the start of each hydrographic station.

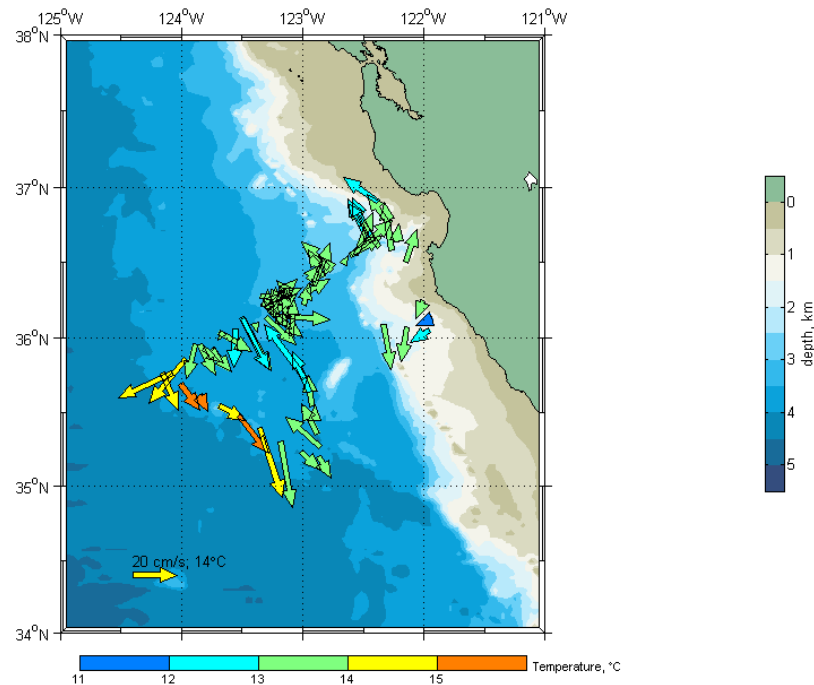
<sup>7</sup> An example of this was the fin whale and unknown large whale, likely another fin, sighted on 25 June during a Beaufort 7 sea state with winds gusting to 60 knots.

*Satellite Imagery:* Advanced Very High Resolution Radiometer (AVHRR) satellite imagery of sea surface temperature of the area of operation during the PaCOOS cruise is included as Figure 7.



**Figure 7.** Advanced Very High Resolution Radiometer (AVHRR) satellite imagery of sea surface temperature ( $^{\circ}\text{C}$ ) of the area of operation during the PaCOOS cruise of June 2008. These images were taken on 24 June 2008 at 2031 UT (left) and 2212 UT (right).

*ADCP*: Continuous ocean current measurements were made throughout the cruise using a vessel-mounted RD Instruments 75 kHz broadband Acoustic Doppler Current Profiler (ADCP). Some results from the ADCP are shown in Figure 8.



**Figure 8.** *ADCP results from the PaCOOS cruise of June 2008.* The arrows are current vectors for currents averaged between 50 and 100 m. The colors of the current vectors reflect the sea surface temperature as measured (nominally at 3 meters) by the ship’s underway data acquisition system.

### **Tabulated Data (in Appendix A)**

The following tables of data can be found in Appendix A:

1) *Table A1: Meteorological and Sea Surface Data*

This lists the meteorological and surface oceanographic conditions at the start of each hydrographic station as measured by the underway data acquisition system of the *R/V Point Sur*.

2) *Table A2: Hydrographic Data*

This is a chronological listing of the hydrographic data collected at each CTD station during the cruise. Data are given for standard pressures, except that the last line of data for each site is the deepest pressure for that CTD cast. The surface pressure, listed as 0 dbar, is actually 1 dbar. Salinities (oxygen) have been adjusted according to the conductivity/salinity (oxygen) calibration correction determined from the collected salinity (oxygen/Winkler) water samples. The time listed for

each station is the beginning (UT) of the CTD cast. Units of geopotential anomaly ( $\Delta\Phi$ ), potential density ( $\sigma_\theta$ ), and potential spiciness ( $\pi_\theta$ ) are  $\text{m}^2\text{s}^{-2}$ ,  $\text{kg m}^{-3}$ , and  $\text{kg m}^{-3}$ , respectively.

3) *Table A3: Nutrient and Primary Productivity Data*

This is a chronological listing of the results of the nutrient and primary productivity analyses of the water samples collected from the 12 Niskin bottles tripped at each hydrographic station. The time given is the start (UT) for each hydrographic station. Except where primary productivity analyses were not performed (see Introduction), the data for each hydrographic station are separated into two sections (“Physical and Chemical” and “Biological”).

The physical oceanographic properties listed in the first seven columns of the “Physical and Chemical” section of each station’s data are the uncorrected values measured by the CTD at the times each Niskin bottle was tripped. Because they are uncorrected, these values may differ slightly from those listed in Table A2. The last four columns of this section of each station’s data give the nitrate ( $\text{NO}_3$ ), nitrite ( $\text{NO}_2$ ), phosphate ( $\text{PO}_4$ ), and dissolved silicate ( $\text{SiO}_4$ ) concentrations (determined as described previously).

The “Biological” section of each station’s data gives the results of the primary productivity analyses. As stated above, primary productivity sampling was not undertaken at every hydrographic station.

4) *Table A4: Marine Mammal Data*

This table lists the results of the marine mammal observations made during the cruise. The data are listed alphabetically by species’ scientific name, then chronologically within each species.

5) *Table A5: Marine Mammal Data Summary*

This table summarizes the (more specific) results from Table A4 of the marine mammal observations made during the cruise. The data are listed alphabetically by species’ scientific name, except that pinnipeds/southern sea otters are listed last.

### **Figures of Results (in Appendix B)**

Graphical representations of the data collected during this cruise follow the tabulated data in Appendix A. Figure 9 is a series of four diagrams contouring (a) the temperature ( $^{\circ}\text{C}$ ), (b) the salinity, (c) the density anomaly ( $\text{kg m}^{-3}$ ), and (d) the oxygen ( $\mu\text{mol kg}^{-1}$ ) fields along the line of hydrographic stations from Moss Landing, California, to CalCOFI station 67-75.

Figure 10 contours the fluorescence and transmissivity in the upper 100 meters of the water column along the line of hydrographic stations from Moss Landing, California, to CalCOFI station 67-75.

Figure 11 is a series of four diagrams contouring (a) the nitrate ( $\mu\text{M}$ ), (b) nitrite ( $\mu\text{M}$ ), (c) phosphate ( $\mu\text{M}$ ), and (d) silicate ( $\mu\text{M}$ ) fields along the line of hydrographic stations from Moss Landing, California, to CalCOFI station 67-75.

### Cruise Participants

Personnel	Duties	Affiliation
Marguerite Blum <i>Monique Messie</i>	Nutrients, Primary Productivity, Oxygens <i>Nutrients, Primary Productivity</i>	Monterey Bay Aquarium Research Institute
Tarry Rago (Chief Scientist) <i>Tetyana Margolina</i> Katherine Whitaker	Physical Oceanography <i>Physical Oceanography,</i> Marine Mammal Observer	Naval Postgraduate School
Eric Ettner <i>Jen Aragon</i> David Gotesman	Phytoplankton Net Tows <i>Nutrients</i> Phytoplankton Net Tows	University of California, Santa Cruz
Adriane Tabag <i>Miguel Arrellano</i>	Nutrients <i>Nutrients</i>	MATE Program
Ben Jokinen (ship's tech.)	Physical Oceanography	Moss Landing Marine Laboratories

### Literature Cited

- Chavez, F. P., R. T. Barber, A. Huyer, P. M. Kosro, S. R. Ramp, T. Stanton, and B. Rojas de Mendiola, Horizontal advection and the distribution of nutrients in the coastal transition zone off northern California: effects on primary production, phytoplankton biomass and species composition, *J. Geophys. Res.*, **96**, 14833-14848, 1991.
- Collins, C. A., J. T. Pennington, C. G. Castro, T. A. Rago, and F.P. Chavez, The California Current system off Monterey, California: physical and biological coupling, *Deep-Sea Res. II*, **50**, 2389-2404, 2003.
- Holm-Hansen, O., C. J. Lorenzen, R. W. Holmes, and J. D. H. Strickland, Fluorometric determination of chlorophyll, *J. Cons. Perm. Int. Explor. Mer*, **30**, 3-15, 1965.
- Kramer, D., M. J. Kalin, E. G. Stevens, J. R. Thrailkill, and J. R. Zweifel, Collecting and processing data on fish eggs and larvae in the California Current region, *NOAA Tech. Rep. NMFS CIRC-370*, 38 pp., Seattle, WA, 1972.
- Owens, W. B., and R. C. Millard Jr., A new algorithm for CTD oxygen calibration, *J. Phys. Oceanogr.*, **15**, 621-631, 1985.
- Parsons, T. R., Y. Maita, and C. M. Lalli, A manual of chemical and biological methods for seawater analysis, 173 pp., Pergamon Press, New York, 1984.
- Pennington, J. T., and F. P. Chavez, Seasonal fluctuations of temperature, salinity, nitrate, chlorophyll and primary production at station H3/M1 over 1989-1996 in Monterey Bay, California, *Deep-Sea Res. II*, **47**, 947-973, 2000.
- Rago, T. A., R. Michisaki, B. Marinovic, and K. Whitaker, Physical, nutrient, and biological measurements of coastal waters off central California in October 2005, *NPS Tech. Rep. No. NPS-OC-06-001*, 75 pp., 2006.
- Rago, T. A., R. Michisaki, B. Marinovic, M. Blum, and K. Whitaker, Physical, nutrient, and biological measurements of coastal waters off central California in June/July 2006, *NPS Tech. Rep. No. NPS-OC-07-001*, 79 pp., 2007a.
- Rago, T. A., R. Michisaki, B. Marinovic, M. Blum, and K. Whitaker, Physical, nutrient, and biological measurements of coastal waters off central California in October 2006, *NPS Tech. Rep. No. NPS-OC-07-002*, 93 pp., 2007b.
- Rago, T. A., R. Michisaki, B. Marinovic, M. Blum, and K. Whitaker, Physical, nutrient, and biological measurements of coastal waters off central California in June 2007, *NPS Tech. Rep. No. NPS-OC-07-008*, 87 pp., 2007c.
- Rago, T. A., R. Michisaki, B. Marinovic, M. Blum, and K. Whitaker, Physical, nutrient, and biological measurements of coastal waters off central California in November 2007, *NPS Tech. Rep. No. NPS-OC-08-004*, 79 pp., 2008.

Sakamoto, C. M., G. E. Friederich, and L. A. Codispoti, MBARI procedures for automated nutrient analyses using a modified Alpkem Series 300 Rapid Flow Analyzer, *MBARI Tech. Rep. No. 90-2*, 84 pp., 1990.

Steger, J. M., F. B. Schwing, C. A. Collins, L. K. Rosenfeld, N. Garfield, and E. Gezgin, The circulation and water masses in the Gulf of the Farallones, *Deep-Sea Res. II*, **47**, 907-946, 2000.

UNESCO, Background papers and supporting data on the Practical Salinity Scale, 1978, *UNESCO Tech. Pap. In Mar. Sci.*, No. 37, 1981.

Venrick, E. L., and T. L. Hayward, Determining chlorophyll on the 1984 CalCOFI surveys, *CalCOFI Rep.* 25, 74-78, 1984.

## Appendix A

**Table A1:** *Meteorological and sea surface data collected during the PaCOOS cruise of June 2008.* Listed here are the meteorological and surface oceanographic conditions as measured by the underway data acquisition system (UDAS) of the *R/V Point Sur* at the beginning of each hydrographic station. Continuous measurements of the water being pumped through the ship's uncontaminated seawater system ("sea chest") from approximately 3 meters below the surface supplied the oceanographic data, while instrumentation mostly atop the ship's mast supplied the meteorological data.

Station	Yearday, 2008 (UTC)	Barometric Pressure (mb)	Wind Speed (kts)	Wind Direction (°T)	Air Temp. (°C)	SST (°C)	SSS
1	175.7257	1016.45	8.62	276.22	10.3	12.611	33.746
2	175.8118	1016.65	16.96	283.58	10.6	11.779	33.736
3	175.9243	1015.99	20.45	322.41	11.2	11.573	33.828
4	176.0819	1014.87	18.82	321.88	11.4	12.474	33.375
5	176.2458	1015.46	19.87	322.13	12.4	13.057	33.279
6	176.3562	1014.26	19.45	325.98	12.4	12.333	33.051
7	176.4993	1013.91	16.67	332.63	12.8	12.913	33.313
8	176.6576	1014.94	21.97	333.22	12.9	13.089	33.353
9	177.0931	1015.82	28.27	323.51	12.9	12.546	33.089
10	177.2326	1016.92	28.15	323.91	13.3	12.634	32.794
11	177.3750	1016.34	29.18	330.31	13.2	12.742	32.724
12	179.2069	1010.95	2.30	304.12	11.2	11.772	33.533
13	179.3257	1009.81	6.02	172.03	11.0	11.421	33.880
14	179.4333	1009.04	7.91	167.15	10.8	10.497	33.868



**Table A2:** *List at standard pressures of hydrographic data collected during the PaCOOS cruise of June 2008. Stations are in chronological order. For each cast, the surface pressure (listed as 0 dbar) is actually 1 dbar, while the last pressure is the deepest pressure of the cast. Salinities and oxygens have been adjusted according to the calibration corrections determined from the collected salinity and oxygen water samples. The time listed for each station is the beginning (<mm/dd/yyyy, hhmm> UT) of the CTD cast. Units of geopotential anomaly ( $\Delta\Phi$ ), potential density ( $\sigma_\theta$ ), and potential spiciness ( $\pi_\theta$ ) are  $\text{m}^2\text{s}^{-2}$ ,  $\text{kg m}^{-3}$ , and  $\text{kg m}^{-3}$ , respectively.*

**Station:** 1 **Date:** 06/23/2008, 1729 **Lat.:** 36° 47.70 N **Long.:** 121° 50.89 W

P(dbar)	T(°C)	S	O <sub>2</sub> ( $\mu\text{m/kg}$ )	Xmiss(%)	$\Delta\Phi$	$\sigma_\theta$	$\pi_\theta$
0	12.547	33.925	349.9	62.7	0.023	25.649	0.759
10	11.546	33.909	278.8	73.9	0.224	25.827	0.554
20	10.224	33.902	210.1	87.0	0.427	26.057	0.309
30	9.838	33.941	176.9	89.2	0.617	26.153	0.273
50	9.463	33.967	153.2	89.1	0.983	26.236	0.231
75	8.968	34.018	120.7	86.7	1.411	26.356	0.191
100	8.829	34.024	114.2	87.2	1.827	26.382	0.172
125	8.734	34.034	110.1	88.5	2.238	26.406	0.165
150	8.607	34.044	102.1	86.8	2.644	26.434	0.153
200	8.146	34.090	82.2	83.3	3.435	26.540	0.118
250	7.760	34.130	64.9	78.2	4.169	26.629	0.091
292	7.651	34.142	60.2	79.0	4.773	26.655	0.084

**Station:** 2 **Date:** 06/23/2008, 1929 **Lat.:** 36° 44.18 N **Long.:** 122° 01.29 W

P(dbar)	T(°C)	S	O <sub>2</sub> ( $\mu\text{m/kg}$ )	Xmiss(%)	$\Delta\Phi$	$\sigma_\theta$	$\pi_\theta$
0	11.735	33.918	304.5	71.1	0.022	25.799	0.597
10	11.534	33.916	287.4	74.5	0.218	25.835	0.557
20	10.233	33.900	209.2	89.1	0.416	26.054	0.309
30	9.521	33.886	172.5	91.4	0.605	26.162	0.177
50	9.288	34.013	129.1	91.1	0.959	26.300	0.238
75	9.073	34.069	103.3	90.9	1.378	26.378	0.247
100	8.932	34.073	98.4	90.9	1.788	26.405	0.228
125	8.875	34.104	84.2	90.9	2.193	26.439	0.243
150	8.831	34.128	74.6	90.9	2.593	26.465	0.254
200	8.426	34.127	71.5	91.1	3.372	26.527	0.189
250	8.156	34.168	55.0	91.3	4.118	26.601	0.180
300	7.681	34.194	45.2	91.7	4.831	26.692	0.130
400	7.131	34.229	32.5	91.6	6.173	26.798	0.078
500	6.527	34.255	23.9	91.0	7.438	26.902	0.016
600	5.789	34.301	17.6	89.9	8.584	27.033	-0.043
700	5.152	34.338	13.1	90.7	9.640	27.140	-0.090
800	4.744	34.377	13.1	90.6	10.602	27.218	-0.106
900	4.387	34.411	17.3	89.2	11.506	27.284	-0.119
1000	4.130	34.435	20.5	88.3	12.356	27.331	-0.127
1010	4.112	34.437	20.8	88.4	12.440	27.334	-0.128

Station: 3 Date: 06/23/2008, 2211 Lat.: 36° 42.67 N Long.: 122° 14.36 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	11.542	33.937	300.7	70.8	0.021	25.849	0.575
10	11.543	33.936	300.6	71.0	0.215	25.849	0.574
20	11.426	33.929	292.4	73.3	0.428	25.865	0.547
30	11.319	33.922	284.1	76.3	0.641	25.879	0.521
50	10.661	33.935	233.8	88.4	1.055	26.007	0.411
75	9.624	33.943	159.8	90.3	1.532	26.191	0.238
100	9.135	33.961	138.5	91.0	1.978	26.285	0.172
125	8.607	33.995	110.8	91.5	2.404	26.395	0.115
150	8.460	34.018	98.1	91.4	2.810	26.435	0.109
200	8.176	34.124	65.5	91.5	3.590	26.563	0.149
250	8.015	34.188	52.2	91.6	4.325	26.637	0.175
300	7.759	34.237	38.1	91.8	5.028	26.715	0.176
400	7.008	34.214	34.9	92.0	6.373	26.804	0.050
500	5.804	34.185	27.7	92.1	7.610	26.939	-0.131
600	5.663	34.298	13.5	92.0	8.734	27.046	-0.060
700	5.061	34.321	10.7	92.0	9.779	27.136	-0.114
800	4.778	34.366	10.0	91.9	10.752	27.205	-0.111
900	4.358	34.407	12.1	92.0	11.655	27.285	-0.124
1000	4.167	34.435	15.1	91.6	12.510	27.327	-0.123
1010	4.144	34.437	15.6	91.6	12.594	27.332	-0.124

Station: 4 Date: 06/24/2008, 0158 Lat.: 36° 37.77 N Long.: 122° 25.25 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	12.456	33.479	278.0	83.6	0.026	25.321	0.389
10	12.439	33.480	278.1	83.6	0.264	25.326	0.387
20	12.353	33.483	275.0	84.0	0.528	25.345	0.372
30	10.799	33.610	239.4	90.2	0.768	25.730	0.179
50	9.450	33.722	183.4	91.5	1.182	26.046	0.034
75	9.324	33.912	164.2	91.6	1.648	26.216	0.164
100	8.826	33.952	136.8	91.6	2.087	26.326	0.115
125	8.552	33.993	112.0	91.5	2.508	26.401	0.104
150	8.384	34.032	93.9	91.4	2.911	26.458	0.109
200	7.670	34.029	85.9	91.6	3.685	26.562	-0.001
250	7.317	34.083	65.0	91.8	4.414	26.656	-0.009
300	6.715	34.072	60.1	91.9	5.104	26.730	-0.101
400	5.654	34.090	43.6	92.1	6.379	26.880	-0.224
500	5.335	34.186	23.9	92.1	7.546	26.996	-0.187
600	5.524	34.339	10.9	92.0	8.614	27.095	-0.045
700	4.958	34.365	9.8	92.0	9.607	27.183	-0.091
800	4.495	34.408	12.0	91.8	10.521	27.270	-0.108
900	4.243	34.428	14.1	92.0	11.379	27.313	-0.120
1000	4.118	34.448	16.5	92.0	12.210	27.343	-0.118
1009	4.102	34.450	16.8	92.0	12.284	27.346	-0.118

Station: 5 Date: 06/24/2008, 0554 Lat.: 36° 32.57 N Long.: 122° 35.88 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	13.054	33.388	281.0	83.3	0.028	25.134	0.437
10	13.055	33.388	281.4	83.2	0.282	25.134	0.437
20	13.038	33.387	281.2	83.3	0.565	25.136	0.432
30	11.388	33.234	268.5	87.5	0.841	25.331	-0.012
50	10.929	33.539	256.7	90.2	1.338	25.652	0.146
75	9.229	33.683	171.7	91.5	1.882	26.052	-0.033
100	9.638	33.959	135.3	91.6	2.350	26.202	0.253
125	8.719	33.949	124.2	91.6	2.789	26.341	0.096
150	8.246	33.985	110.7	91.7	3.199	26.442	0.051
200	7.778	34.021	91.5	91.8	3.976	26.541	0.009
250	7.168	34.060	71.4	91.9	4.709	26.658	-0.049
300	6.886	34.101	55.4	92.0	5.402	26.730	-0.055
400	5.867	34.092	44.8	92.1	6.698	26.856	-0.196
500	5.308	34.177	25.3	92.2	7.878	26.991	-0.197
600	5.304	34.330	10.8	92.1	8.946	27.114	-0.078
700	4.870	34.382	9.9	92.0	9.913	27.207	-0.087
800	4.459	34.403	11.4	92.1	10.815	27.270	-0.116
900	4.200	34.432	14.1	92.1	11.671	27.320	-0.122
1000	3.965	34.456	17.6	92.1	12.489	27.365	-0.127
1010	3.935	34.462	18.7	92.1	12.569	27.372	-0.126

Station: 6 Date: 06/24/2008, 0832 Lat.: 36° 27.35 N Long.: 122° 46.39 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	12.323	33.160	282.4	84.4	0.029	25.099	0.109
10	12.326	33.163	282.7	84.5	0.285	25.101	0.112
20	12.374	33.372	278.2	86.4	0.567	25.254	0.288
30	11.776	33.461	269.5	88.5	0.830	25.436	0.242
50	10.224	33.628	225.4	91.2	1.290	25.844	0.092
75	9.089	33.740	160.7	91.6	1.792	26.119	-0.010
100	9.139	33.953	148.6	91.6	2.242	26.278	0.166
125	8.875	34.003	124.8	91.4	2.670	26.359	0.163
150	8.515	34.028	100.8	91.3	3.082	26.435	0.126
200	7.626	34.012	95.4	91.8	3.864	26.556	-0.020
250	7.068	34.029	78.4	91.9	4.593	26.648	-0.087
300	6.929	34.105	54.5	92.0	5.284	26.727	-0.046
400	6.056	34.131	38.9	92.1	6.579	26.863	-0.141
500	5.305	34.170	23.9	92.1	7.758	26.986	-0.203
600	4.937	34.251	13.2	92.2	8.820	27.094	-0.182
700	4.682	34.323	9.3	92.2	9.812	27.180	-0.155
800	4.350	34.376	9.5	92.2	10.731	27.260	-0.149
900	4.055	34.422	12.9	92.2	11.586	27.327	-0.144
1000	3.863	34.466	19.4	92.2	12.387	27.383	-0.129
1010	3.804	34.463	19.1	92.2	12.465	27.387	-0.138

Station: 7 Date: 06/24/2008, 1159 Lat.: 36° 22.67 N Long.: 122° 57.28 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	12.908	33.419	280.5	82.6	0.028	25.186	0.432
10	12.910	33.419	281.1	82.5	0.277	25.186	0.432
20	12.912	33.419	281.5	82.5	0.555	25.186	0.432
30	12.214	33.429	272.6	87.1	0.831	25.330	0.302
50	10.174	33.584	223.3	91.0	1.298	25.818	0.048
75	9.617	33.734	185.5	91.4	1.815	26.028	0.071
100	8.848	33.817	147.2	91.6	2.287	26.218	0.012
125	8.540	33.898	133.6	91.7	2.724	26.329	0.028
150	8.494	34.007	112.7	91.5	3.138	26.422	0.106
200	7.967	34.071	73.6	91.5	3.923	26.552	0.076
250	7.292	34.064	69.4	91.8	4.657	26.644	-0.028
300	6.878	34.087	58.3	91.9	5.352	26.720	-0.067
400	5.997	34.144	35.1	92.0	6.640	26.881	-0.138
500	5.578	34.211	20.1	92.1	7.808	26.987	-0.138
600	5.083	34.278	11.8	92.0	8.880	27.099	-0.144
700	4.642	34.333	8.8	92.1	9.862	27.193	-0.150
800	4.343	34.376	8.9	92.1	10.773	27.260	-0.150
900	4.036	34.413	11.4	92.2	11.629	27.322	-0.153
1000	3.786	34.443	14.5	92.2	12.435	27.372	-0.155
1008	3.763	34.445	14.8	92.2	12.497	27.376	-0.156

Station: 8 Date: 06/24/2008, 1547 Lat.: 36° 17.53 N Long.: 123° 08.06 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	13.086	33.460	279.1	84.5	0.028	25.183	0.501
10	13.077	33.459	280.1	84.5	0.278	25.184	0.497
20	13.062	33.458	280.3	84.5	0.555	25.187	0.494
30	11.839	33.496	271.0	88.7	0.822	25.452	0.282
50	10.368	33.643	232.1	91.0	1.287	25.831	0.129
75	9.143	33.812	164.3	91.6	1.774	26.166	0.055
100	8.717	33.921	134.7	91.6	2.220	26.320	0.074
125	8.657	34.001	110.2	91.4	2.637	26.392	0.127
150	8.342	34.041	91.6	91.4	3.040	26.472	0.110
200	7.889	34.104	65.0	91.5	3.800	26.589	0.091
250	7.630	34.152	50.0	91.6	4.519	26.666	0.090
300	6.985	34.135	47.1	92.0	5.207	26.744	-0.014
400	5.857	34.101	42.4	92.1	6.491	26.865	-0.189
500	5.342	34.185	23.4	92.1	7.663	26.994	-0.186
600	5.133	34.309	11.4	92.1	8.723	27.117	-0.114
700	4.682	34.346	9.4	92.1	9.696	27.198	-0.136
800	4.371	34.394	10.5	92.1	10.601	27.271	-0.133
900	4.091	34.435	14.3	92.1	11.447	27.335	-0.130
1000	3.799	34.461	18.1	92.2	12.239	27.386	-0.139
1009	3.776	34.463	18.5	92.2	12.309	27.389	-0.140

Station: 9 Date: 06/25/2008, 0215 Lat.: 36° 07.53 N Long.: 123° 29.34 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	12.580	33.242	286.3	81.2	0.028	25.113	0.225
10	12.642	33.259	286.0	81.3	0.284	25.115	0.251
20	12.491	33.238	285.1	82.4	0.568	25.128	0.204
30	12.073	33.170	281.6	84.6	0.849	25.155	0.068
50	10.247	32.988	255.9	90.3	1.402	25.340	-0.416
75	9.433	33.301	227.2	91.6	2.015	25.720	-0.304
100	9.028	33.522	190.2	91.7	2.552	25.958	-0.194
125	8.915	33.844	144.6	91.6	3.028	26.228	0.043
150	8.736	33.947	134.0	91.5	3.466	26.338	0.096
200	7.836	33.993	108.1	91.7	4.271	26.510	-0.005
250	7.174	34.049	80.0	91.9	5.012	26.649	-0.056
300	6.569	34.065	62.0	92.0	5.702	26.744	-0.126
400	5.681	34.101	42.8	92.1	6.970	26.886	-0.211
500	5.540	34.216	21.0	92.0	8.132	26.995	-0.139
600	5.120	34.284	12.3	92.1	9.206	27.100	-0.135
700	4.774	34.335	9.9	92.0	10.202	27.180	-0.135
800	4.403	34.389	10.0	92.0	11.121	27.264	-0.133
900	4.059	34.432	13.9	92.1	11.965	27.335	-0.136
1000	3.813	34.463	18.4	92.2	12.758	27.385	-0.137
1008	3.795	34.465	18.8	92.2	12.820	27.389	-0.137

Station: 10 Date: 06/25/2008, 0534 Lat.: 36° 02.63 N Long.: 123° 40.16 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	12.616	32.894	285.6	83.4	0.031	24.837	-0.045
10	12.624	32.894	286.7	83.3	0.311	24.835	-0.044
20	12.622	32.893	287.1	83.3	0.621	24.835	-0.045
30	11.615	32.859	279.4	87.7	0.928	24.998	-0.269
50	11.204	32.885	268.4	90.7	1.510	25.094	-0.325
75	10.358	33.000	251.1	91.5	2.204	25.331	-0.387
100	9.676	33.346	210.0	91.7	2.826	25.716	-0.228
125	8.912	33.644	165.8	91.7	3.354	26.072	-0.116
150	8.778	33.892	121.9	91.7	3.815	26.288	0.060
200	8.097	33.974	130.8	91.8	4.646	26.456	0.018
250	7.619	34.037	87.8	91.9	5.419	26.576	-0.003
300	7.154	34.082	65.6	92.0	6.138	26.678	-0.034
400	6.407	34.151	38.7	92.0	7.464	26.834	-0.080
500	5.745	34.210	23.6	92.0	8.668	26.965	-0.119
600	5.258	34.269	13.6	92.0	9.764	27.072	-0.131
700	4.797	34.330	9.7	92.0	10.771	27.173	-0.136
800	4.422	34.383	9.5	92.0	11.696	27.258	-0.135
900	4.093	34.407	11.0	92.1	12.559	27.311	-0.152
1000	3.804	34.439	14.1	92.1	13.373	27.367	-0.156
1009	3.762	34.443	15.2	92.2	13.444	27.375	-0.157

Station: 11 Date: 06/25/2008, 0900 Lat.: 35° 57.26 N Long.: 123° 50.74 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	12.732	32.823	282.8	84.8	0.032	24.759	-0.078
10	12.730	32.823	283.4	84.8	0.318	24.760	-0.079
20	12.732	32.823	283.7	84.8	0.636	24.759	-0.079
30	12.730	32.823	283.5	84.9	0.954	24.760	-0.080
50	11.763	32.840	279.4	87.2	1.576	24.957	-0.256
75	11.265	32.895	270.7	90.1	2.308	25.091	-0.307
100	10.553	33.023	251.9	91.5	3.003	25.317	-0.334
125	9.789	33.257	215.0	91.7	3.634	25.629	-0.280
150	9.059	33.600	167.5	91.8	4.180	26.015	-0.128
200	8.380	33.937	137.1	91.8	5.087	26.385	0.032
250	7.781	34.017	106.1	91.9	5.884	26.537	0.005
300	7.239	34.064	75.4	92.0	6.626	26.652	-0.036
400	5.992	34.074	52.2	92.1	7.968	26.826	-0.194
500	5.376	34.158	28.5	92.1	9.169	26.969	-0.203
600	4.901	34.242	14.1	92.2	10.250	27.091	-0.193
700	4.571	34.322	9.0	92.2	11.236	27.192	-0.167
800	4.150	34.359	9.0	92.2	12.138	27.267	-0.183
900	3.956	34.404	10.5	92.2	12.988	27.323	-0.169
1000	3.711	34.445	15.2	92.2	13.790	27.381	-0.161
1013	3.673	34.451	16.4	92.2	13.890	27.390	-0.160

Station: 12 Date: 06/27/2008, 0459 Lat.: 36° 57.32 N Long.: 122° 24.92 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	11.744	33.623	270.4	83.6	0.024	25.567	0.365
10	11.453	33.678	262.3	85.3	0.238	25.664	0.353
20	11.006	33.738	252.6	87.4	0.463	25.792	0.319
30	10.889	33.844	251.3	86.2	0.677	25.896	0.381
50	9.290	33.954	150.3	89.9	1.059	26.253	0.192
75	9.049	34.055	104.7	89.9	1.484	26.372	0.233
100	8.999	34.078	95.6	89.8	1.899	26.398	0.243
125	8.892	34.108	78.6	89.7	2.301	26.439	0.249
150	8.818	34.110	75.3	89.8	2.702	26.452	0.238
200	8.788	34.134	67.4	89.7	3.495	26.477	0.251
250	8.675	34.138	63.8	89.7	4.284	26.498	0.236
263	8.650	34.134	64.0	89.5	4.488	26.499	0.228

Station: 13 Date: 06/27/2008, 0747 Lat.: 37° 15.54 N Long.: 122° 37.84 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	11.439	33.954	350.4	70.8	0.021	25.882	0.569
10	11.210	33.942	322.7	70.2	0.210	25.914	0.517
20	10.252	33.931	248.0	79.4	0.412	26.075	0.337
30	9.760	33.961	214.4	84.6	0.600	26.181	0.276
50	8.932	34.019	137.8	87.2	0.942	26.361	0.186
75	8.319	34.062	64.0	83.6	1.339	26.490	0.124
92	8.308	34.062	61.5	82.3	1.602	26.492	0.122

Station: 14 Date: 06/27/2008, 1023 Lat.: 37° 33.62 N Long.: 122° 50.84 W

P(dbar)	T(°C)	S	O <sub>2</sub> (μm/kg)	Xmiss(%)	ΔΦ	σ <sub>θ</sub>	π <sub>θ</sub>
0	10.490	33.948	257.3	80.0	0.020	26.047	0.392
10	10.444	33.944	255.2	80.9	0.195	26.052	0.381
20	10.231	33.937	244.3	81.7	0.389	26.083	0.338
30	9.877	33.946	211.4	84.8	0.578	26.150	0.284
50	9.063	33.994	151.5	88.9	0.934	26.321	0.187
75	8.667	34.039	93.2	88.0	1.343	26.419	0.159
81	8.597	34.046	83.8	86.4	1.440	26.435	0.154

**Table A3:** *Results of nutrient and primary productivity analyses of water samples collected at each hydrographic station during the PaCOOS cruise of June 2008. Stations are in chronological (and numerical) order. The time listed (<Mon. dd, yyyy hh:mm> UT) for each station is the beginning of the CTD cast. 12 Niskin bottles were tripped at each station, although some bottles sampled duplicate pressures. Except where primary productivity analyses were not performed (see Introduction), the data for each station are separated into two sections (“Physical and Chemical” and “Biological”).*

The physical oceanographic properties listed in the first seven columns of the “Physical and Chemical” section of each station’s data are the uncorrected values measured by the CTD at the times each Niskin bottle was tripped. Because they are uncorrected, these values may differ slightly from those listed in Table A2. The last four columns of this section give the nitrate (NO<sub>3</sub>), nitrite (NO<sub>2</sub>), phosphate (PO<sub>4</sub>), and dissolved silicate (SiO<sub>4</sub>) concentrations.

The “Biological” section of each station’s data gives the results of the primary productivity analyses where such sampling was undertaken.

Date	Jun 23, 2008 17:27	Cruise:	<b>S308</b>	Latitude:	36.795	Year:	2008
Project:	CALCOFI	Station:	<b>C1</b>	Longitude:	-121.848	Work week:	26
Platform:	POINT SUR	Cast:	<b>1</b>	Secchi Depth:	---	Day of Year:	175

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

#### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (μM)	NO2 (μM)	PO4 (μM)	SIO4 (μM)	O2 (ml l-1)
0	0.7	12	12.419	33.909	25.661	63	7.800	0.321	0.989	7.550	7.195
5	4.6	11	12.395	33.904	25.662	64	15.769	0.356	1.286	14.600	6.971
10	10.2	10	10.426	33.885	26.009	86	22.066	0.401	1.873	22.318	4.531
20	19.6	9	10.016	33.911	26.099	89	23.252	0.409	1.910	24.263	3.934
30	30.4	8	9.787	33.919	26.144	90	24.255	0.347	2.074	25.505	3.528
40	40.1	7	9.737	33.921	26.155	91	24.868	0.334	2.130	26.971	3.460
60	60.5	6	9.193	33.976	26.287	86	27.112	0.247	2.331	35.732	2.770
80	81.0	5	8.988	33.998	26.337	87	27.755	0.551	2.260	36.614	2.515
100	101.0	4	8.817	34.009	26.373	88	28.915	0.237	2.290	38.109	2.399
150	151.7	3	8.581	34.030	26.427	86	29.475	0.238	2.450	40.315	2.132
200	201.0	2	8.206	34.073	26.518	84	29.590	0.212	2.427	43.331	1.730
290	291.7	1	7.634	34.132	26.649	80	33.289	0.238	2.670	54.105	1.292

#### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)	DEP (m)	% S. I.	CARBON (mg m-3 d-1)	PROD INDEX carbon/chl (mg m-3 d-1)	LIGHT DEPTH (m)
0	12	16.783	2.245	0	100	1133.749	67.554	0
5	11	6.110	1.396	0	50	1156.882	68.932	2
10	10	1.773	1.372	5	30	683.927	111.941	3
20	9	0.981	0.993	5	15	225.109	36.844	5
30	8	0.500	0.628	5	5	215.063	35.200	10
40	7	0.405	0.660	10	1	10.077	5.685	19
60	6	0.255	0.847	20	0.1	1.058	1.079	35
80	5	0.166	0.569					
100	4	0.148	0.543					
150	3	0.137	0.652					
200	2	0.132	0.925					
290	1	0.098	0.726					

#### Integrated Value

*Integrated values are 1.0% of Surface Intensity (S.I.)*

Chlorophyll <i>a</i> :	121.65	mg m-2 day -1	Carbon Fixation:	6322.5	mg m-2 day-1
Phaeophytin:	27.92	mg m-2 day -1	Productivity Index:	51.97	mg C mg Chl day-1
Mixed Layer	3	meters	PBOpt:	111.94	mg C mg Chl day-1



Date Jun 23, 2008 19:29 Cruise: **S308** Latitude: 36.736 Year: 2008  
 Project: CALCOFI Station: **H3** Longitude: -122.022 Work week: 26  
 Platform: POINT SUR Cast: **2** Secchi Depth: --- Day of Year: 175

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	0.6	12	11.735	33.902	25.786	70	10.138	0.416	0.889	9.086	6.543
5	5.6	11	11.694	33.902	25.794	71	10.639	0.349	1.271	9.729	6.500
10	10.1	10	11.442	33.899	25.838	75	16.866	0.314	1.375	16.864	5.955
20	21.0	9	9.682	33.865	26.119	91	24.863	0.141	1.656	26.729	3.875
30	30.4	8	9.550	33.908	26.175	91	26.857	0.173	1.899	30.405	3.465
40	39.9	7	9.359	33.961	26.247	91	27.594	0.138	2.343	32.229	2.983
60	59.8	6	9.225	34.011	26.309	91	29.518	0.265	2.325	37.361	2.497
80	80.7	5	8.994	34.056	26.381	91	---	---	---	---	2.098
100	100.3	4	8.961	34.063	26.392	91	29.972	0.188	2.344	38.393	1.991
150	150.6	3	8.799	34.115	26.459	91	31.065	0.181	2.378	40.890	1.511
200	202.1	2	8.398	34.114	26.522	91	31.891	0.021	2.529	43.137	1.444
1000	1008.6	1	4.117	34.426	27.325	88	42.570	0.032	3.153	116.80	0.471

### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)	DEP (m)	% S. I.	CARBON (mg m-3 d-1)	PROD INDEX carbon/chl (mg m-3 d-1)	LIGHT DEPTH (m)
0	12	11.691	3.460	0	100	1267.742	108.433	0
5	11	11.503	3.473	0	50	1444.839	123.581	2
10	10	6.298	2.176	5	30	659.032	57.293	3
20	9	0.375	0.384	5	15	677.419	58.891	5
30	8	0.201	0.317	10	5	71.613	11.370	8
40	7	0.203	0.365	10	1	106.452	16.902	14
60	6	0.148	0.272	20	0.1	0.968	2.579	29
80	5	0.126	0.326					
100	4	0.105	0.276					
150	3	0.056	0.289					
200	2	0.036	0.222					
1000	1	0.021	0.173					

### Integrated Value

Integrated values are 1.0% of Surface Intensity (S.I.)

Chlorophyll <i>a</i> :	122.60	mg m-2 day -1	Carbon Fixation:	6736.2	mg m-2 day-1
Phaeophytin:	38.91	mg m-2 day -1	Productivity Index:	54.95	mg C mg Chl day-1
Mixed Layer	11	meters	PBOpt:	123.58	mg C mg Chl day-1

Date Jun 23, 2008 22:11 Cruise: **S308** Latitude: 36.711 Year: 2008  
 Project: CALCOFI Station: **NPS1** Longitude: -122.239 Work week: 26  
 Platform: POINT SUR Cast: **3** Secchi Depth: --- Day of Year: 175

*\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.*

# **Physical and Chemical**

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	1.3	12	11.664	33.931	25.822	73	11.519	0.333	0.869	10.237	6.287
50	50.3	11	10.678	33.926	25.998	88	19.010	0.374	1.402	18.671	4.967
100	102.5	10	9.133	33.952	26.278	91	28.092	0.095	2.131	32.083	2.870
200	200.8	9	8.188	34.090	26.534	92	32.408	0.033	2.425	43.278	1.414
300	301.2	8	7.771	34.220	26.699	92	35.488	0.048	2.622	53.028	0.789
400	403.1	7	6.771	34.183	26.811	92	36.786	0.056	3.011	62.845	0.741
500	503.2	6	5.838	34.187	26.936	92	39.783	0.023	3.026	76.693	0.533
600	604.3	5	5.698	34.315	27.055	92	40.744	0.062	3.142	85.014	0.250
700	704.7	4	5.071	34.307	27.124	92	42.064	0.030	2.844	95.422	0.240
800	806.3	3	4.727	34.355	27.202	92	42.617	0.033	2.986	104.34	0.235
900	902.1	2	4.351	34.397	27.277	92	---	---	---	---	0.289
1000	1008.5	1	4.148	34.427	27.323	92	43.524	0.050	3.243	117.47	0.363

Date Jun 24, 2008 01:58 Cruise: **S308** Latitude: 36.629 Year: 2008  
 Project: CALCOFI Station: **67-55** Longitude: -122.421 Work week: 26  
 Platform: POINT SUR Cast: **4** Secchi Depth: --- Day of Year: 176

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	0.3	12	11.918	33.493	25.434	85	13.331	0.340	1.171	18.217	5.755
5	4.5	11	11.925	33.492	25.432	85	12.473	0.242	0.927	14.828	5.753
10	10.2	10	11.932	33.491	25.430	85	12.612	0.254	0.947	14.728	5.748
20	20.6	9	11.909	33.487	25.432	85	15.268	0.345	1.117	16.737	5.702
30	30.9	8	10.681	33.626	25.763	91	18.704	0.477	1.131	19.580	4.865
40	40.7	7	9.959	33.675	25.925	91	22.834	0.167	1.565	23.755	4.155
60	60.5	6	9.377	33.802	26.121	92	25.815	0.000	1.628	27.129	3.610
80	80.9	5	9.287	33.909	26.219	92	26.763	0.000	1.818	29.275	3.318
100	100.8	4	8.836	33.927	26.305	92	28.109	0.000	1.836	31.938	2.860
150	150.1	3	8.394	34.011	26.440	91	31.039	0.005	2.121	38.548	1.928
200	202.5	2	7.781	34.026	26.544	92	32.218	0.000	2.290	43.327	1.744
1000	1006.9	1	4.101	34.440	27.338	92	43.309	0.000	3.355	117.25	0.392

### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)	DEP (m)	% S. I.	CARBON (mg m-3 d-1)	PROD INDEX carbon/chl (mg m-3 d-1)	LIGHT DEPTH (m)
0	12	1.461	0.485	0	100	44.089	30.169	0
5	11	1.301	0.469	5	50	106.593	81.923	4
10	10	1.070	0.423	5	30	98.592	75.773	8
20	9	0.839	0.377	10	15	100.841	94.231	13
30	8	0.401	0.335	20	5	21.591	25.730	22
40	7	0.179	0.251	30	1	3.103	7.744	37
60	6	0.074	0.175	40	0.1	0.221	1.236	68
80	5	0.043	0.191					
100	4	0.020	0.128					
150	3	0.017	0.164					
200	2	0.008	0.114					
1000	1	0.002	0.025					

### Integrated Value

Integrated values are 1.0% of Surface Intensity (S.I.)

Chlorophyll <i>a</i> :	32.13	mg m-2 day -1	Carbon Fixation:	1966.1	mg m-2 day-1
Phaeophytin:	13.71	mg m-2 day -1	Productivity Index:	61.19	mg C mg Chl day-1
Mixed Layer	23	meters	PBOpt:	94.23	mg C mg Chl day-1

Date Jun 24, 2008 05:55 Cruise: **S308** Latitude: 36.543 Year: 2008  
 Project: CALCOFI Station: **NPS2** Longitude: -122.598 Work week: 26  
 Platform: POINT SUR Cast: **5** Secchi Depth: --- Day of Year: 176

*\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.*

# **Physical and Chemical**

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	1.3	12	13.005	33.374	25.132	84	7.928	0.110	0.615	8.785	5.918
50	50.2	11	10.348	33.468	25.698	91	17.810	0.262	1.336	18.117	4.871
100	99.8	10	9.594	33.978	26.224	92	27.836	0.000	2.043	29.908	2.388
200	203.1	9	7.649	34.007	26.548	92	32.778	0.026	2.273	43.582	1.885
300	302.0	8	6.788	34.091	26.735	92	36.899	0.004	2.609	58.338	1.106
400	402.9	7	5.713	34.084	26.868	92	40.099	0.000	2.789	72.554	0.898
500	506.5	6	5.332	34.162	26.977	92	41.503	0.000	2.936	82.645	0.532
600	604.0	5	5.320	34.317	27.102	92	42.158	0.000	3.063	90.578	0.235
700	705.8	4	4.803	34.369	27.203	92	43.333	0.015	3.273	100.62	0.229
800	807.2	3	4.451	34.393	27.263	92	43.868	0.004	3.157	107.59	0.269
900	906.9	2	4.198	34.421	27.312	92	44.016	0.000	3.297	112.54	0.329
1000	1007.7	1	3.939	34.451	27.364	92	44.056	0.017	3.390	117.99	0.428

Date Jun 24, 2008 08:32 Cruise: **S308** Latitude: 36.456 Year: 2008  
 Project: CALCOFI Station: **67-60** Longitude: -122.773 Work week: 26  
 Platform: POINT SUR Cast: **6** Secchi Depth: --- Day of Year: 176

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	1.1	12	12.309	33.155	25.098	84	7.412	0.124	0.570	9.186	5.982
5	3.9	11	12.304	33.153	25.097	84	7.596	0.116	0.658	8.914	5.984
10	10.3	10	12.307	33.152	25.096	84	7.741	0.133	0.713	9.141	5.984
20	21.0	9	12.354	33.332	25.227	86	9.564	0.169	0.790	10.940	5.879
30	30.4	8	11.797	33.455	25.428	88	12.447	0.253	0.975	13.932	5.627
40	40.2	7	10.753	33.566	25.704	91	17.191	0.447	1.240	18.472	5.108
60	60.6	6	9.790	33.639	25.925	91	22.315	0.266	1.469	22.957	4.142
80	81.0	5	9.028	33.752	26.137	92	26.060	0.045	1.684	27.380	3.110
100	100.1	4	8.977	33.886	26.251	92	27.656	0.007	1.731	29.378	3.090
150	151.0	3	8.521	33.994	26.408	91	30.779	0.068	1.937	36.539	2.182
200	200.3	2	7.679	33.995	26.535	92	---	---	---	---	1.977
1000	1007.5	1	3.805	34.453	27.378	92	44.289	0.078	3.463	121.15	0.439

### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)	DEP (m)	% S. I.	CARBON (mg m-3 d-1)	PROD INDEX carbon/chl (mg m-3 d-1)	LIGHT DEPTH (m)
0	12	1.207	0.326	0	100	48.390	40.096	0
5	11	1.179	0.301	5	50	76.349	64.781	5
10	10	1.136	0.357	5	30	79.633	67.568	9
20	9	1.094	0.413	10	15	64.526	56.794	15
30	8	0.839	0.421	20	5	29.896	27.334	24
40	7	0.296	0.245	30	1	6.776	8.075	36
60	6	0.191	0.204	40	0.1	0.452	1.525	62
80	5	0.025	0.099					
100	4	0.025	0.122					
150	3	0.016	0.131					
200	2	0.003	0.084					
1000	1	0.002	0.016					

### Integrated Value

Integrated values are 1.0% of Surface Intensity (S.I.)

Chlorophyll <i>a</i> :	33.43	mg m-2 day -1	Carbon Fixation:	1690.4	mg m-2 day-1
Phaeophytin:	11.45	mg m-2 day -1	Productivity Index:	50.56	mg C mg Chl day-1
Mixed Layer	29	meters	PBOpt:	67.57	mg C mg Chl day-1

Date Jun 24, 2008 11:59 Cruise: **S308** Latitude: 36.377 Year: 2008  
 Project: CALCOFI Station: **NPS3** Longitude: -122.954 Work week: 26  
 Platform: POINT SUR Cast: **7** Secchi Depth: --- Day of Year: 176

*\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.*

# **Physical and Chemical**

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	0.6	12	12.840	33.405	25.189	83	8.276	0.142	0.577	9.633	5.935
50	50.5	11	10.383	33.568	25.770	91	17.999	0.423	1.225	18.685	4.811
100	100.7	10	8.938	33.781	26.175	92	26.089	0.165	1.723	28.107	3.148
200	201.8	9	8.000	34.059	26.538	92	33.354	0.066	2.265	43.121	1.486
300	304.5	8	6.688	34.048	26.715	92	33.939	0.078	2.421	53.138	1.312
400	403.3	7	6.004	34.140	26.877	92	39.607	0.064	2.865	72.123	0.685
500	503.8	6	5.555	34.201	26.982	92	40.556	0.064	3.184	80.548	0.409
600	603.4	5	5.045	34.268	27.095	92	42.718	0.069	3.101	92.635	0.254
700	704.4	4	4.605	34.329	27.194	92	---	---	---	---	0.202
800	805.8	3	4.339	34.368	27.254	92	44.129	0.011	3.327	109.92	0.217
900	905.7	2	4.029	34.402	27.314	92	44.552	0.009	3.173	116.95	0.270
1000	1007.0	1	3.765	34.435	27.368	92	44.307	0.003	3.441	122.94	0.347

Date Jun 24, 2008 15:47 Cruise: **S308** Latitude: 36.292 Year: 2008  
 Project: CALCOFI Station: **67-65** Longitude: -123.134 Work week: 26  
 Platform: POINT SUR Cast: **8** Secchi Depth: --- Day of Year: 176

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	1.1	12	13.039	33.436	25.173	84	8.298	0.170	0.837	7.247	5.952
5	4.8	11	13.044	33.436	25.173	84	---	---	---	---	5.948
10	10.5	10	13.039	33.436	25.174	84	8.287	0.128	0.780	6.906	5.950
20	19.5	9	13.030	33.432	25.173	84	8.721	0.206	0.744	7.986	5.926
30	29.4	8	11.868	33.471	25.427	89	11.348	0.219	1.039	13.029	5.727
40	40.4	7	10.884	33.436	25.579	90	15.773	0.456	1.366	17.360	5.328
60	59.8	6	9.533	33.651	25.977	91	23.487	0.164	1.673	23.992	4.068
80	82.5	5	8.863	33.822	26.219	92	25.820	0.052	1.717	27.901	2.972
100	99.5	4	8.767	33.960	26.343	92	29.089	0.110	2.155	33.070	2.508
150	152.7	3	8.220	34.034	26.485	91	31.832	0.038	2.146	39.879	1.756
200	201.8	2	7.876	34.101	26.589	91	31.316	0.025	2.454	42.600	1.240
1000	1007.8	1	3.780	34.453	27.381	92	44.111	0.019	3.359	121.78	0.425

### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)	DEP (m)	% S. I.	CARBON (mg m-3 d-1)	PROD INDEX carbon/chl (mg m-3 d-1)	LIGHT DEPTH (m)
0	12	1.226	0.386	0	100	34.903	28.475	0
10	10	1.282	0.444	0	50	68.536	55.915	5
20	9	1.226	0.422	10	30	66.714	52.028	8
30	8	0.764	0.390	10	15	60.537	47.210	13
40	7	0.365	0.237	20	5	29.120	23.757	20
60	6	0.114	0.199	30	1	5.720	7.489	32
80	5	0.023	0.086	40	0.1	0.442	1.210	56
100	4	0.019	0.120					
150	3	0.014	0.119					
200	2	0.009	0.127					
1000	1	0.000	0.018					

### Integrated Value

Integrated values are 1.0% of Surface Intensity (S.I.)

Chlorophyll <i>a</i> :	36.61	mg m-2 day -1	Carbon Fixation:	1290.0	mg m-2 day-1
Phaeophytin:	13.16	mg m-2 day -1	Productivity Index:	35.24	mg C mg Chl day-1
Mixed Layer	27	meters	PBOpt:	55.92	mg C mg Chl day-1

Date Jun 25, 2008 02:15 Cruise: **S308** Latitude: 36.125 Year: 2008  
 Project: CALCOFI Station: **67-70** Longitude: -123.489 Work week: 26  
 Platform: POINT SUR Cast: **9** Secchi Depth: --- Day of Year: 177

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	0.5	12	12.028	33.097	25.106	84	7.397	0.169	0.649	9.309	5.980
5	4.9	11	12.045	33.101	25.106	84	7.462	0.138	0.690	9.664	5.987
10	10.0	10	12.125	33.122	25.107	84	7.485	0.146	0.743	9.854	6.006
20	19.3	9	12.099	33.118	25.109	84	7.508	0.182	0.846	10.415	5.976
30	29.4	8	12.110	33.118	25.108	84	7.444	0.150	0.850	10.824	5.973
40	40.2	7	11.203	33.037	25.212	88	9.230	0.168	0.916	11.494	5.634
60	60.9	6	9.524	33.066	25.521	91	14.732	0.088	1.170	18.751	4.938
80	80.1	5	9.366	33.395	25.805	92	21.017	0.027	1.611	20.268	4.525
100	99.5	4	8.886	33.583	26.028	92	23.650	0.024	1.806	24.849	3.581
150	151.3	3	8.617	33.942	26.352	92	28.600	0.015	2.067	32.613	2.479
200	201.1	2	7.760	33.996	26.524	92	28.140	0.091	2.525	36.616	2.025
1000	1006.8	1	3.796	34.454	27.381	92	43.627	0.000	3.362	123.18	0.434

### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)	DEP (m)	% S. I.	CARBON (mg m-3 d-1)	PROD INDEX carbon/chl (mg m-3 d-1)	LIGHT DEPTH (m)
0	12	1.367	0.333	0	100	79.104	57.861	0
5	11	1.377	0.350	5	50	103.036	74.850	5
10	10	1.452	0.371	5	30	124.312	90.306	8
20	9	1.433	0.382	10	15	103.295	71.140	12
30	8	1.518	0.350	20	5	44.859	31.301	19
40	7	0.773	0.293	30	1	11.479	7.562	30
60	6	0.180	0.146	40	0.1	0.442	0.572	48
80	5	0.036	0.086					
100	4	0.014	0.073					
150	3	0.010	0.085					
200	2	0.011	0.087					
1000	1	0.003	0.013					

### Integrated Value

Integrated values are 1.0% of Surface Intensity (S.I.)

Chlorophyll <i>a</i> :	42.36	mg m-2 day -1	Carbon Fixation:	2106.9	mg m-2 day-1
Phaeophytin:	10.71	mg m-2 day -1	Productivity Index:	49.74	mg C mg Chl day-1
Mixed Layer	165	meters	PBOpt:	90.31	mg C mg Chl day-1



Date Jun 25, 2008 05:34 Cruise: **S308** Latitude: 36.044 Year: 2008  
 Project: CALCOFI Station: **NPS5** Longitude: -123.669 Work week: 26  
 Platform: POINT SUR Cast: **10** Secchi Depth: --- Day of Year: 177

*\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.*

# **Physical and Chemical**

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	0.3	12	12.645	32.870	24.813	84	3.588	0.094	0.617	5.231	6.048
50	51.9	11	11.201	32.859	25.074	91	6.296	0.205	0.886	6.989	5.677
100	101.6	10	9.653	33.156	25.571	92	13.992	0.036	1.146	13.449	4.710
200	202.0	9	8.063	33.973	26.461	92	28.775	0.072	1.996	36.693	2.537
300	300.7	8	7.091	34.068	26.676	92	34.973	0.009	---	54.166	1.334
400	403.8	7	6.316	34.137	26.835	92	37.653	0.006	---	67.616	0.783
500	503.7	6	5.683	34.196	26.962	92	40.093	0.003	---	80.804	0.492
600	603.5	5	5.180	34.258	27.072	92	41.568	0.006	3.209	92.146	0.282
700	706.1	4	4.769	34.323	27.171	92	42.765	0.005	3.447	100.93	0.220
800	806.7	3	4.414	34.376	27.253	92	42.627	0.014	3.459	109.14	0.234
900	906.8	2	4.031	34.395	27.309	92	43.888	0.036	3.428	118.17	0.257
1000	1006.5	1	3.772	34.432	27.365	92	44.001	0.021	3.420	124.96	0.352

Date Jun 25, 2008 09:00 Cruise: **S308** Latitude: 35.954 Year: 2008  
 Project: CALCOFI Station: **67-75** Longitude: -123.846 Work week: 26  
 Platform: POINT SUR Cast: **11** Secchi Depth: --- Day of Year: 177

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	2.3	12	12.748	32.805	24.742	85	2.305	0.114	0.571	3.610	5.996
5	5.6	11	12.751	32.805	24.741	85	2.274	0.115	0.724	3.189	5.986
10	11.1	10	12.756	32.805	24.741	85	2.288	0.102	0.702	3.417	5.986
20	20.8	9	12.752	32.805	24.742	85	2.299	0.102	0.756	3.469	5.990
30	30.7	8	12.757	32.804	24.741	85	2.322	0.107	0.659	3.117	5.986
40	41.2	7	12.687	32.805	24.755	85	2.531	0.128	0.706	3.346	5.985
60	60.6	6	11.637	32.845	24.985	88	5.008	0.290	0.758	5.655	5.843
80	80.8	5	11.212	32.898	25.103	91	7.086	0.181	0.850	7.609	5.665
100	101.1	4	10.176	32.987	25.353	91	13.975	0.049	1.184	14.361	5.217
150	149.5	3	8.993	33.636	26.053	92	23.630	0.014	1.716	26.070	3.408
200	200.9	2	8.297	33.939	26.399	92	27.821	0.000	2.018	33.998	2.619
1000	1008.1	1	3.686	34.439	27.380	92	43.718	0.000	3.345	127.95	0.377

### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)	DEP (m)	% S. I.	CARBON (mg m-3 d-1)	PROD INDEX carbon/chl (mg m-3 d-1)	LIGHT DEPTH (m)
0	12	0.905	0.214	0	100	44.044	48.659	0
5	11	0.886	0.232	5	50	62.425	70.434	5
10	10	0.886	0.206	5	30	68.374	77.147	10
20	9	0.924	0.221	10	15	72.991	82.356	15
30	8	0.915	0.257	20	5	35.446	38.361	24
40	7	0.896	0.205	30	1	7.614	8.325	36
60	6	0.877	0.383	40	0.1	0.327	0.365	54
80	5	0.339	0.221					
100	4	0.043	0.064					
150	3	0.012	0.041					
200	2	0.004	0.031					
1000	1	0.000	0.001					

### Integrated Value

Integrated values are 1.0% of Surface Intensity (S.I.)

Chlorophyll <i>a</i> :	32.63	mg m-2 day -1	Carbon Fixation:	1677.6	mg m-2 day-1
Phaeophytin:	8.19	mg m-2 day -1	Productivity Index:	51.41	mg C mg Chl day-1
Mixed Layer	---	meters	PBOpt:	82.36	mg C mg Chl day-1

Date Jun 27, 2008 04:58 Cruise: **S308** Latitude: 36.955 Year: 2008  
 Project: CALCOFI Station: **62.25-52.5** Longitude: -122.415 Work week: 26  
 Platform: POINT SUR Cast: **12** Secchi Depth: --- Day of Year: 179

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	0.3	12	11.729	33.606	25.557	83	13.880	0.302	0.563	16.125	5.767
5	4.9	11	11.721	33.605	25.558	83	14.436	0.363	0.693	16.341	5.736
10	10.1	10	11.481	33.625	25.618	85	15.623	0.384	0.641	16.517	5.497
20	20.2	9	11.205	33.726	25.747	87	15.793	0.361	---	14.724	5.333
30	30.1	8	11.186	33.846	25.844	86	16.845	0.244	1.217	15.381	5.520
40	39.7	7	9.461	33.727	26.048	90	24.712	0.114	1.646	27.782	3.707
60	60.5	6	9.119	33.985	26.306	90	28.858	0.078	1.767	34.600	2.501
80	80.7	5	9.050	34.037	26.357	90	29.504	0.108	1.807	36.772	2.173
100	99.7	4	8.990	34.068	26.391	90	30.151	0.118	1.846	38.325	1.886
150	150.3	3	8.807	34.096	26.443	90	30.945	0.125	1.858	40.687	1.581
200	201.0	2	8.786	34.121	26.467	90	31.405	0.069	1.861	41.501	1.424
260	261.6	1	8.652	34.121	26.489	89	31.540	0.116	2.420	42.443	1.386

### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)
0	12	1.405	0.410
5	11	1.301	0.399
10	10	1.160	0.426
20	9	1.329	0.565
30	8	1.546	0.577
40	7	0.471	0.454
60	6	0.157	0.560
80	5	0.126	0.610
100	4	0.124	0.675
150	3	0.075	0.522
200	2	0.069	0.433

### Integrated Value

*Integrated values are 1.0% of Surface Intensity (S.I.)*

Chlorophyll <i>a</i> :	---	mg m-2 day -1	Carbon Fixation:	---	mg m-2 day-1
Phaeophytin:	---	mg m-2 day -1	Productivity Index:	---	mg C mg Chl day-1
Mixed Layer	---	meters	PBOpt:	---	mg C mg Chl day-1

Date Jun 27, 2008 07:48 Cruise: **S308** Latitude: 37.259 Year: 2008  
 Project: CALCOFI Station: **63.5-52.5** Longitude: -122.631 Work week: 26  
 Platform: POINT SUR Cast: **13** Secchi Depth: --- Day of Year: 179

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (µM)	NO2 (µM)	PO4 (µM)	SIO4 (µM)	O2 (ml l-1)
0	0.8	12	11.496	33.951	25.869	71	8.814	0.293	0.549	13.421	7.584
5	5.2	11	11.471	33.949	25.872	70	8.623	0.296	0.684	13.519	7.467
10	9.9	10	11.339	33.938	25.887	69	13.980	0.351	1.161	18.798	7.099
20	20.7	9	10.135	33.929	26.093	81	20.733	0.344	1.829	27.976	4.916
30	31.0	8	9.500	33.975	26.235	86	24.144	0.295	1.905	33.531	3.945
40	39.9	7	9.143	33.995	26.309	87	27.049	0.232	2.383	40.365	3.285
60	60.5	6	8.558	34.031	26.430	87	30.801	0.244	2.556	50.096	1.906
80	81.1	5	8.310	34.050	26.482	83	31.133	0.281	2.745	55.558	1.310
80	80.8	4	8.310	34.050	26.482	83	30.965	0.280	2.787	55.924	1.313
80	80.7	3	8.311	34.050	26.482	83	31.147	0.260	2.782	56.041	1.315
90	90.6	2	8.309	34.050	26.483	82	31.014	0.280	2.717	56.193	1.341
90	91.0	1	8.308	34.050	26.483	82	30.875	0.343	2.725	55.440	1.357

### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)
0	12	11.031	3.151
5	11	10.371	2.930
10	10	11.503	3.385
20	9	4.809	2.503
30	8	1.414	1.836
40	7	0.594	1.599
60	6	0.358	1.641
80	5	0.405	2.308
80	4	0.377	2.362
80	3	0.462	2.410
90	2	0.453	2.481
90	1	0.368	2.645

### Integrated Value

*Integrated values are 1.0% of Surface Intensity (S.I.)*

Chlorophyll <i>a</i> :	---	mg m-2 day -1	Carbon Fixation:	---	mg m-2 day-1
Phaeophytin:	---	mg m-2 day -1	Productivity Index:	---	mg C mg Chl day-1
Mixed Layer	31	meters	PBOpt:	---	mg C mg Chl day-1

Date Jun 27, 2008 10:23 Cruise: **S308** Latitude: 37.560 Year: 2008  
 Project: CALCOFI Station: **61.75-52.5** Longitude: -122.847 Work week: 26  
 Platform: POINT SUR Cast: **14** Secchi Depth: --- Day of Year: 179

\* Note: Latitude and Longitude are reported in decimal degrees. '---' signifies no data.

### Physical and Chemical

DEP (m)	PRESS (db)	BTL #	TEMP (°C)	SAL (psu)	SIGMA T	TRANSMISS (%)	NO3 (μM)	NO2 (μM)	PO4 (μM)	SIO4 (μM)	O2 (ml l-1)
0	0.9	12	10.498	33.932	26.033	80	18.787	0.290	1.221	25.160	5.503
5	4.5	11	10.504	33.932	26.032	80	22.563	0.322	1.425	30.639	5.495
10	10.0	10	10.404	33.927	26.045	80	22.508	0.316	1.516	29.663	5.413
20	19.7	9	10.056	33.926	26.104	84	24.450	0.307	1.760	31.248	4.675
30	30.4	8	9.500	33.942	26.209	88	26.377	0.320	1.911	34.254	3.712
40	40.5	7	9.203	33.956	26.269	89	27.314	0.308	2.018	36.238	3.462
60	59.5	6	8.753	34.019	26.390	88	29.623	0.254	2.225	41.588	2.071
80	79.9	5	8.595	34.034	26.426	87	29.974	0.259	2.356	45.083	1.790
80	80.1	4	8.591	34.034	26.427	86	29.970	0.263	2.320	44.811	1.801
80	80.0	3	8.613	34.032	26.422	87	29.794	0.270	2.325	44.691	1.823
80	79.9	2	8.596	34.034	26.426	87	29.915	0.268	2.306	44.085	1.811
80	80.6	1	8.597	34.034	26.426	87	29.836	0.268	2.380	42.866	1.829

### Biological

DEP (m)	BTL #	CHL (mg m-3 d-1)	PHAEO (mg m-3 d-1)
0	12	5.657	1.390
5	11	5.855	1.624
10	10	6.525	1.562
20	9	3.291	1.413
30	8	1.028	0.822
40	7	0.415	0.766
60	6	0.217	1.166
80	5	0.245	1.737

### Integrated Value

*Integrated values are 1.0% of Surface Intensity (S.I.)*

Chlorophyll <i>a</i> :	---	mg m-2 day -1	Carbon Fixation:	---	mg m-2 day-1
Phaeophytin:	---	mg m-2 day -1	Productivity Index:	---	mg C mg Chl day-1
Mixed Layer	---	meters	PBOpt:	---	mg C mg Chl day-1

**Table A4:** *Marine mammal observations.* This table lists the results of the marine mammal observations made during the PaCOOS cruise of June 2008. The data are listed alphabetically by species' scientific name, then chronologically within each species.

Species Code	Scientific Name	Group Size	Sighting Number	Date (m/dd/yyyy)	North Latitude (dd mm.mmm)	West Longitude (ddd mm.mmm)
74	<i>Balaenoptera physalus</i>	1	13	6/25/2008	36° 36.617	123° 48.053
17	<i>Delphinus delphis</i>	20	12	6/25/2008	35° 38.488	124° 04.875
17	<i>Delphinus delphis</i>	8	15	6/25/2008	35° 13.375	122° 57.790
21	<i>Grampus griseus</i>	23	47	6/27/2008	37° 03.433	122° 22.761
21	<i>Grampus griseus</i>	45	48	6/27/2008	36° 53.941	122° 08.981
22	<i>Lagenorhynchus obliquidens</i>	320	8	6/23/2008	36° 45.300	121° 57.600
22	<i>Lagenorhynchus obliquidens</i>	5	18	6/25/2008	35° 16.932	122° 51.686
22	<i>Lagenorhynchus obliquidens</i>	850	24b	6/26/2008	36° 15.067	122° 00.450
22	<i>Lagenorhynchus obliquidens</i>	200	25a	6/26/2008	36° 15.067	122° 00.450
22	<i>Lagenorhynchus obliquidens</i>	400	26a	6/26/2008	36° 15.689	122° 01.066
27	<i>Lissodelphis borealis</i>	600	24c	6/26/2008	36° 15.067	122° 00.450
27	<i>Lissodelphis borealis</i>	150	25b	6/26/2008	36° 15.067	122° 00.450
27	<i>Lissodelphis borealis</i>	220	26b	6/26/2008	36° 15.689	122° 01.066
76	<i>Megaptera novaeangliae</i>	3	2	6/23/2008	36° 48.283	121° 47.580
76	<i>Megaptera novaeangliae</i>	2	3	6/23/2008	36° 47.700	121° 50.880
76	<i>Megaptera novaeangliae</i>	2	4	6/23/2008	36° 47.700	121° 50.940
76	<i>Megaptera novaeangliae</i>	1	5	6/23/2008	36° 47.940	121° 51.000
76	<i>Megaptera novaeangliae</i>	2	6	6/23/2008	36° 48.060	121° 51.840
76	<i>Megaptera novaeangliae</i>	9	7	6/23/2008	36° 45.300	121° 57.720
76	<i>Megaptera novaeangliae</i>	2	9	6/23/2008	36° 44.340	122° 00.180
76	<i>Megaptera novaeangliae</i>	2	10	6/23/2008	36° 43.800	122° 14.400
76	<i>Megaptera novaeangliae</i>	2	21	6/26/2008	36° 15.355	122° 06.664
76	<i>Megaptera novaeangliae</i>	6	24a	6/26/2008	36° 15.067	122° 00.450

Species Code	Scientific Name	Group Size	Sighting Number	Date (m/dd/yyyy)	North Latitude (dd mm.mmm)	West Longitude (ddd mm.mmm)
76	<i>Megaptera novaeangliae</i>	2	30	6/27/2008	37° 29.080	122° 47.409
76	<i>Megaptera novaeangliae</i>	2	31	6/27/2008	37° 28.090	122° 46.478
76	<i>Megaptera novaeangliae</i>	1	32	6/27/2008	37° 26.994	122° 45.507
76	<i>Megaptera novaeangliae</i>	1	33	6/27/2008	37° 26.854	122° 46.390
76	<i>Megaptera novaeangliae</i>	1	34	6/27/2008	37° 26.854	122° 45.390
76	<i>Megaptera novaeangliae</i>	2	35	6/27/2008	37° 24.790	122° 42.050
76	<i>Megaptera novaeangliae</i>	2	36	6/27/2008	37° 24.330	122° 40.590
76	<i>Megaptera novaeangliae</i>	3	37	6/27/2008	37° 22.403	122° 37.126
76	<i>Megaptera novaeangliae</i>	2	38	6/27/2008	37° 21.379	122° 36.085
76	<i>Megaptera novaeangliae</i>	2	39	6/27/2008	37° 20.929	122° 35.643
76	<i>Megaptera novaeangliae</i>	3	40	6/27/2008	37° 19.829	122° 34.524
76	<i>Megaptera novaeangliae</i>	3	42	6/27/2008	37° 19.039	122° 33.777
76	<i>Megaptera novaeangliae</i>	4	43	6/27/2008	37° 18.758	122° 33.508
76	<i>Megaptera novaeangliae</i>	1	44	6/27/2008	37° 15.350	122° 31.853
76	<i>Megaptera novaeangliae</i>	1	45	6/27/2008	37° 09.842	122° 28.799
76	<i>Megaptera novaeangliae</i>	1	50	6/27/2008	36° 50.801	121° 59.577
76	<i>Megaptera novaeangliae</i>	2	51	6/27/2008	36° 50.801	121° 59.577
76	<i>Megaptera novaeangliae</i>	1	52	6/27/2008	36° 48.284	121° 48.936
40	<i>Phocoena phocoena</i>	3	53	6/27/2008	36° 48.201	121° 47.884
44	<i>Phocoenoides dalli</i>	5	11	6/24/2008	36° 05.056	123° 20.182
44	<i>Phocoenoides dalli</i>	3	20	6/26/2008	37° 02.209	122° 44.783
44	<i>Phocoenoides dalli</i>	3	29	6/26/2008	36° 23.444	122° 05.652
44	<i>Phocoenoides dalli</i>	9	41	6/27/2008	37° 19.829	122° 34.524
44	<i>Phocoenoides dalli</i>	5	49	6/27/2008	36° 53.596	122° 08.312
46	<i>Physeter macrocephalus</i>	7	22	6/26/2008	36° 11.120	121° 58.350
79	unidentified large whale	1	14	6/25/2008	35° 37.158	123° 47.144
79	unidentified large whale	1	23	6/26/2008	36° 16.089	121° 54.863
79	unidentified large whale	1	46	6/27/2008	36° 16.089	121° 54.863

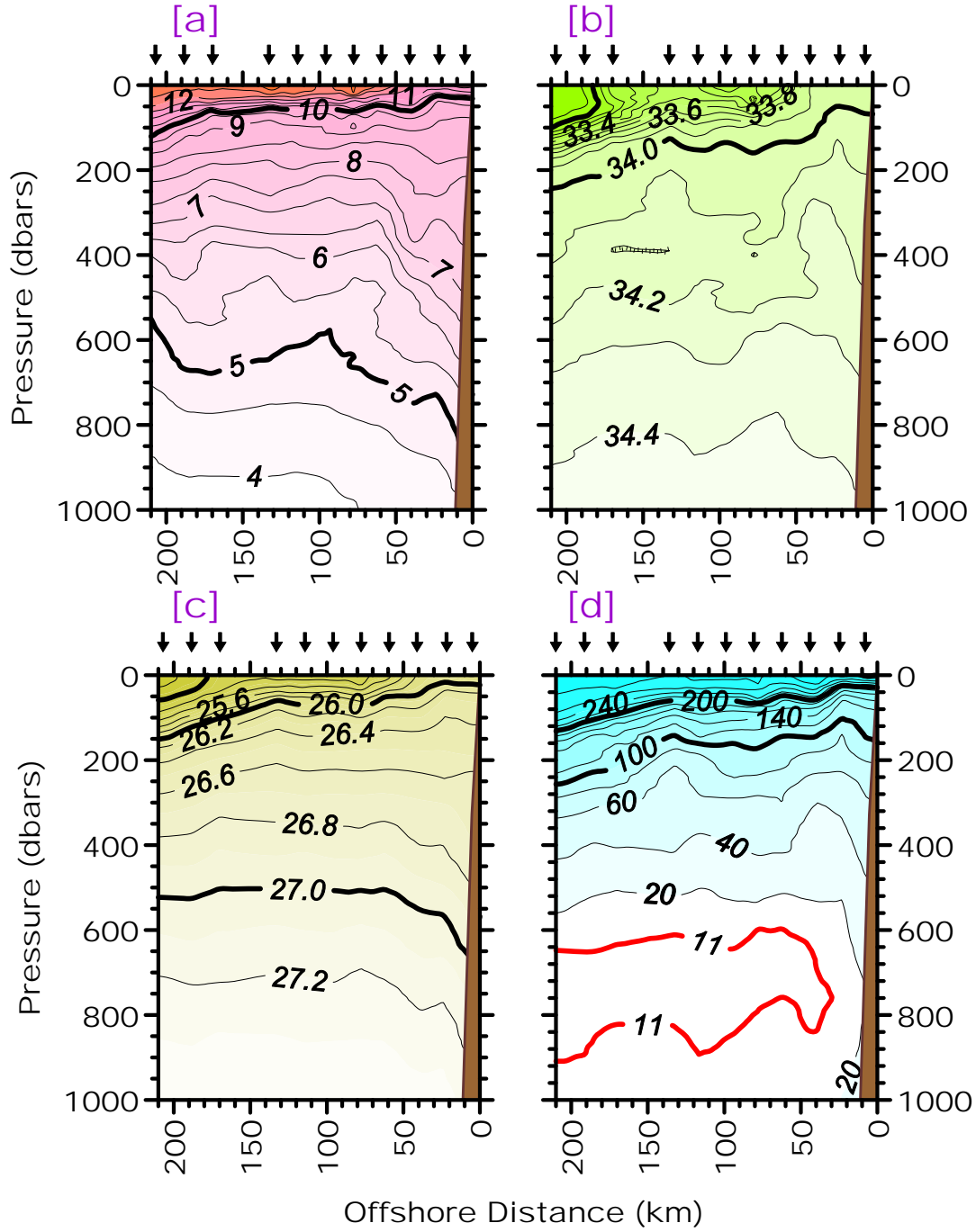
Species Code	Scientific Name	Group Size	Sighting Number	Date (m/dd/yyyy)	North Latitude (dd mm.mmm)	West Longitude (ddd mm.mmm)
<b>PINNIPEDS and SOUTHERN SEA OTTERS</b>						
CU	<i>Callorhinus ursinus</i>	1	16	6/25/2008	35° 11.733	122° 52.600
CU	<i>Callorhinus ursinus</i>	1	17	6/25/2008	35° 15.391	122° 51.371
MA	<i>Mirounga angustirostris</i>	1	28	6/26/2008	36° 20.800	122° 04.147
PV	<i>Phoca vitulina</i>	1	54	6/27/2008	36° 48.283	121° 47.580
EL	<i>Enhydra lutris</i>	26	1	6/24/2008	36° 48.283	121° 47.580
EL	<i>Enhydra lutris</i>	37	55	6/27/2008	36° 48.283	121° 47.580



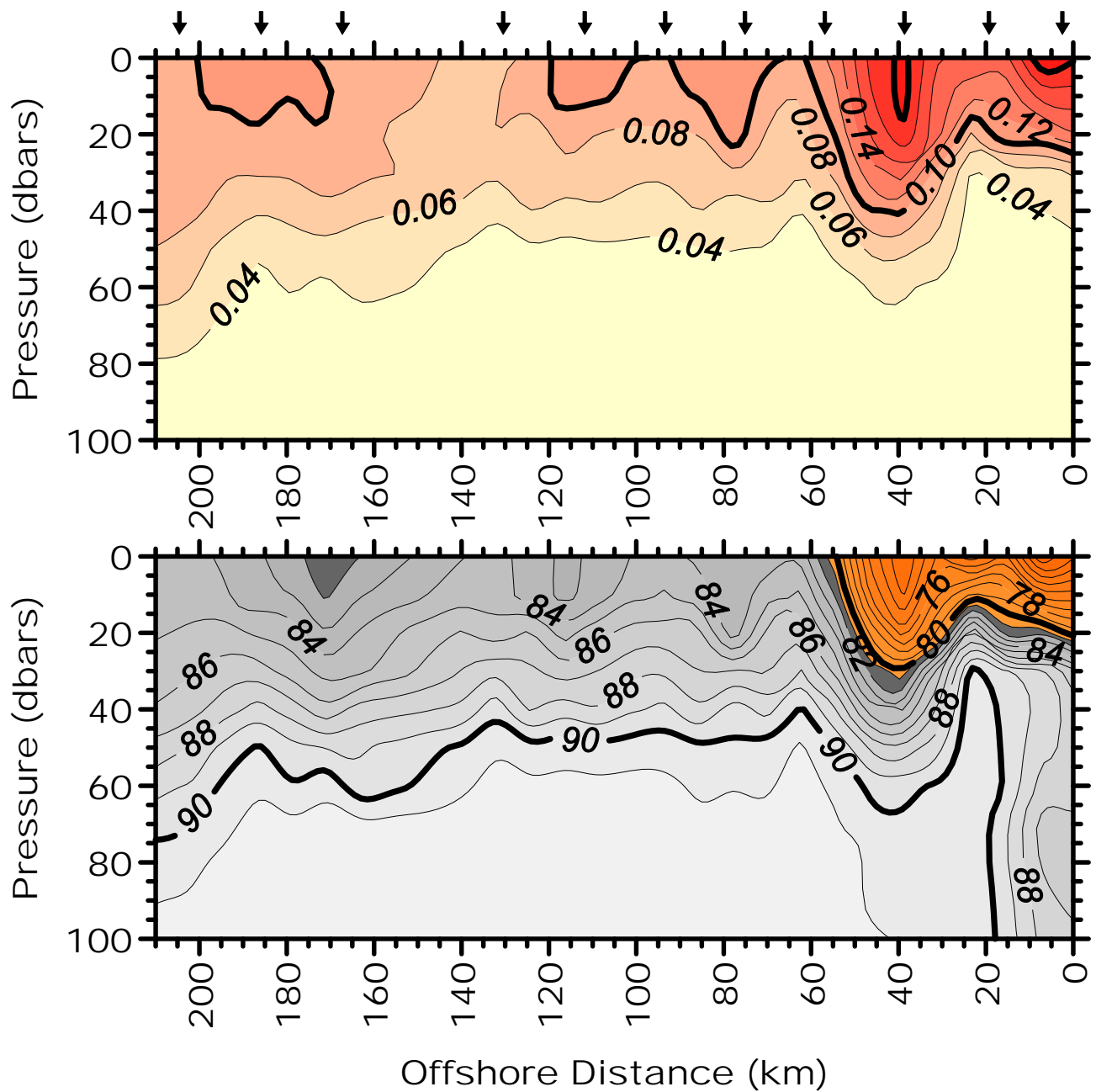
**Table A5:** *Summary of marine mammal observations.* This table summarizes the results of the marine mammal observations made during the PaCOOS cruise of June 2008. The data are listed alphabetically by species' scientific name, except that pinnipeds/southern sea otters are listed last.

Species Code	Scientific Name	Total sightings	Total animals
71	<i>Balaenoptera acutorostrata</i>	1	1
74	<i>Balaenoptera physalus</i>	1	1
17	<i>Delphinus delphis</i>	2	28
21	<i>Grampus griseus</i>	2	68
22	<i>Lagenorhynchus obliquidens</i>	5	1775
27	<i>Lissodelphis borealis</i>	3	970
76	<i>Megaptera novaeangliae</i>	28	65
40	<i>Phocoena phocoena</i>	1	3
44	<i>Phocoenoides dalli</i>	5	25
46	unidentified whale	1	7
141	<i>Callorhinus ursinus</i>	3	3
<b>Total number of cetaceans</b>			<b><u>2946</u></b>

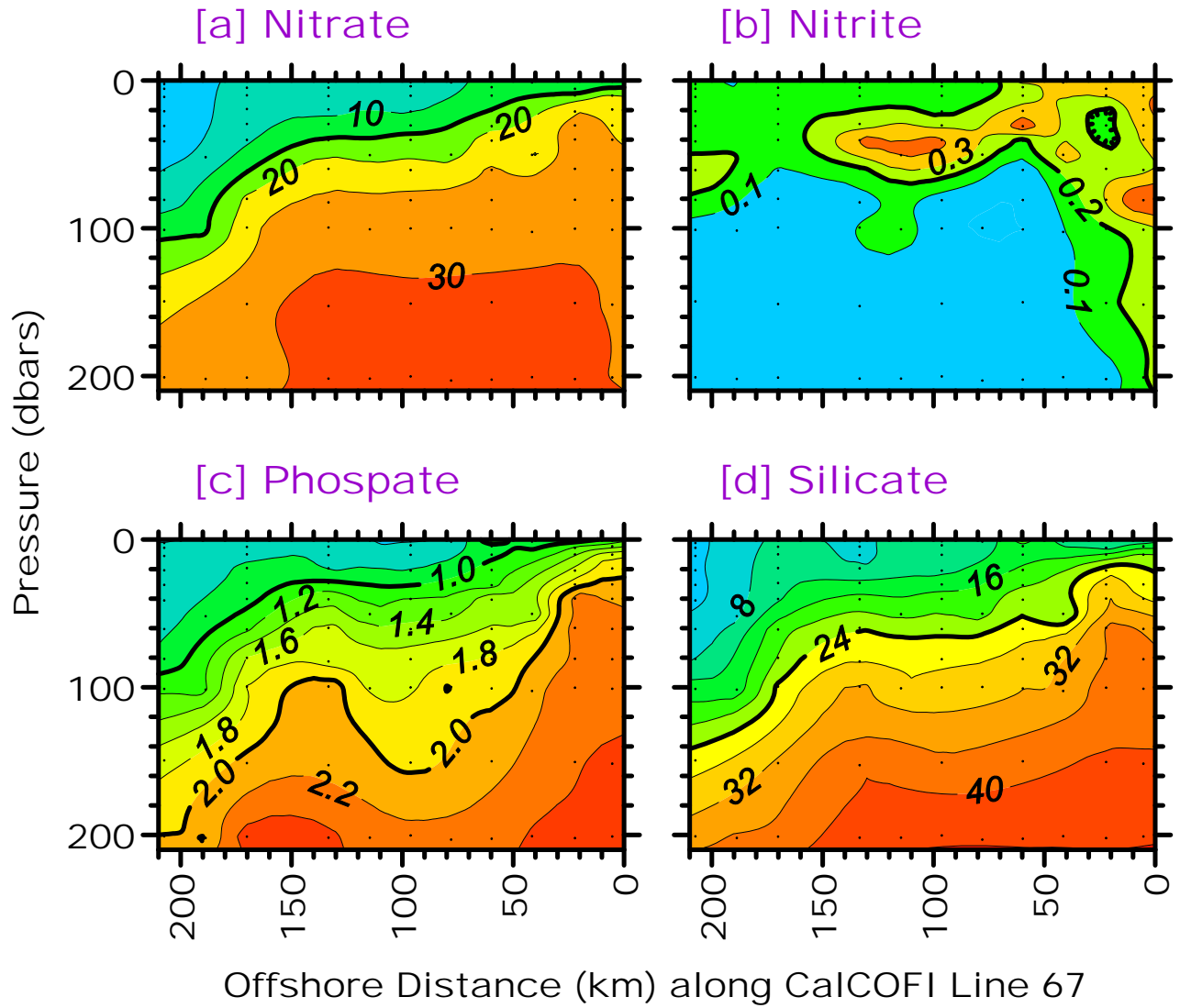
## Appendix B



**Figure 9:** Contours of (a) temperature ( $^{\circ}\text{C}$ ), (b) salinity, (c) density anomaly ( $\text{kg m}^{-3}$ ), and (d) oxygen ( $\mu\text{mol kg}^{-1}$ ) fields along the line of hydrographic stations from Moss Landing, California (on the right), to CalCOFI station 67-75. Arrows along the top axes indicate the locations of the hydrographic stations. Contour intervals for panels a-d are  $0.5^{\circ}\text{C}$ ,  $0.1$ ,  $0.2 \text{ kg m}^{-3}$ , and  $20 \mu\text{mol kg}^{-1}$ , respectively, except that the (nearly) oxygen minimum contour of  $11 \mu\text{mol kg}^{-1}$  is highlighted in red in panel d.



**Figure 10:** Contours of fluorescence (volts) [upper panel] and transmissivity (percentage) [lower panel] in the upper 100 dbars of the water column along the line of hydrographic stations from Moss Landing, California (on the right), to CalCOFI station 67-75. The arrows along the upper axis of the upper panel indicate the locations of the hydrographic stations. The contour intervals are 0.02 volts and 1 percent, respectively, for the upper and lower panels.



**Figure 11:** Contours of (a) nitrate ( $\mu\text{M}$ ), (b) nitrite ( $\mu\text{M}$ ), (c) phosphate ( $\mu\text{M}$ ), and (d) silicate ( $\mu\text{M}$ ) fields along the line of hydrographic stations from Moss Landing, California (on the right), to CalCOFI station 67-75. The dots indicate the water sample locations. Contour intervals for panels a-d are  $5\mu\text{M}$ ,  $0.1\mu\text{M}$ ,  $0.2\mu\text{M}$ , and  $4\mu\text{M}$ , respectively.

## Appendix C

The following is the introduction from the manual for the Seatech transmissometer that was mounted on the CTD during the PaCOOS cruise of June 2008.

The Sea Tech 25 cm pathlength transmissometer has been designed to provide accurate in situ measurements of beam transmission and the concentration of suspended matter in relatively clear waters.

The two basic processes that alter the underwater distribution of light are absorption and scattering. Absorption is a change of light energy into other forms of energy whereas scattering entails a change in direction of the light without loss of energy.

In a pure absorbing medium, the loss of light due to absorption in a well-collimated beam of monochromatic light will be given by  $I(z) = I(o)e^{-az}$ , where "a" is the absorption coefficient with units of  $m^{-1}$ . Similarly, in a pure scattering medium, the light redirected from a well-collimated beam of monochromatic light will be given by  $I(z) = I(o)e^{-bz}$ , where "b" is the volume scattering coefficient with units of  $m^{-1}$ . Since attenuation is defined as the sum of absorption and scattering, we get  $a + b = c$ , where "c" is the beam attenuation coefficient.

The light lost from a well-collimated monochromatic beam of light in a scattering and absorbing medium is thus given by  $I(z) = I(o)e^{-Cz}$ . This can be rewritten as  $T(z) = I(z)/I(o) = e^{-Cz}$ , where  $T(z)$  is the percent light transmitted over a distance, "z". It should be noted that transmission is always over a given distance, whereas the beam attenuation coefficient, "c", is independent of distance. "c" is computed by  $-\ln(T)/z$ , where z is the pathlength of the instrument.

The simple exponential relationship holds only if the light is monochromatic. The Sea Tech transmissometer employs a light emitting diode (LED) light source with a wavelength of 660 nm, which is in the red part of the spectrum. This LED is nearly monochromatic.

A beam attenuation coefficient, "c", can be divided into three parts: 1) That due to water,  $c_w$ ; 2) that due to suspended particulate matter,  $c_p$ ; and 3) that due to dissolved materials (mostly humic acids or "yellow matter"),  $c_y$ . Hence,  $c = c_w + c_p + c_y$ . Each of these components has distinct spectral characteristics. Yellow matter absorbs strongly in the blue part of the spectrum. This absorption decreases exponentially with increasing wavelengths. The beam attenuation coefficient for particulate matter is much less wavelength dependent. It varies approximately as  $\lambda^{-1}$ . The attenuation spectrum of natural waters is a composite of the three components, depending on the relative concentrations. The yellow matter is a by-product of organic decay and can be present in large amounts in lakes, reservoirs, and near-shore waters. At 660 nm, the attenuation of yellow matter is negligible, however, so that the attenuation is due to particulate matter and sea water only.

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